Attachment D. Materials Testing Program

III. MATERIALS TESTING PROGRAM

The Sites complex has many sources for fine-grained soil and rock construction materials. The reservoir area upstream of the Sites and Golden Gate dam sites has an abundance of Quaternary terrace deposits, and the reservoir's eastern boundary ridges are dominated by exposures of the Cortina formation, predominately sandstone with thin claystone bedding.

The focus of the construction materials investigation was to perform classification and strength tests on the fine grained soil and rock materials available in the Sites complex to determine their suitability for use as core, random fill, rockfill, riprap, and concrete aggregate. Results of the materials testing program are included in Appendix A.

3.1 DESCRIPTION OF SAMPLES

3.1.1 Rockfill/Riprap/Concrete Aggregates

Sandstone is the predominate construction material available in the Cortina formation. The sandstone is a Cretaceous marine sedimentary rock, fine- to medium-grained, well cemented with a variable color that is indicative of the state of weathering. The fresh material has a light blue gray appearance, and the weathered material has a brownish color. An operational quarry located approximately one quarter mile downstream of the Sites Dam site is representative of the rock materials available for construction of the dams and appurtenant structures.

3.1.2 Core and Random Zone Materials

The USBR identified areas in the valleys upstream from the two dam sites comprised of Quaternary terrace deposits and alluvium that contain an estimated 36 million cubic yards of material. These sites are characterized by lean clay, with lesser amounts of clayey gravely sand, sandy clay, and silty sand.

3.2 SAMPLING PROGRAM

3.2.1 Rockfill/Riprap/Concrete Aggregates

Samples for compressive strength, tensile strength, and elastic moduli were obtained by coring into large slabs from the Sites quarry. The extracted cores were 6-inch diameter by 12 inches, with 13 samples each of the fresh and weathered sandstone.

Quarry stones were used to prepare 2.5-inch x 5-inch x 5-inch samples for durability testing. The DWR Bryte Soils and Concrete Lab retrieved twelve samples each of the fresh and weathered sandstone in April 1999.

Samples for aggregate testing were prepared with random waste cobbles from the Sites quarry operator's debris piles. Samples were segregated into fresh and weathered sandstone lots and transported for crushing to Valley Rock Products in Orland. A rock crusher processed the samples until material passed a 1-inch screen. Approximately two cubic yards of each the fresh and weathered material passing the 1-inch screen, including fines, were transported to the DWR Bryte Soils and Concrete Lab for testing.

3.2.2 Core and Random Zone Materials

The fine-grained materials were sampled from the valleys upstream from the two dam sites (Figures 3.1 and 3.2). Test pits were excavated and DWR Northern District geologists logged and collected samples at approximate depths of 5, 10 and 15 feet below the ground surface. All sampling sites were located horizontally and vertically to within one-foot accuracy. Samples were bagged and identified with the test pit name, the sample depth, and the date of sampling. Bag samples were approximately one cubic foot (130 pounds).

Previously, the USBR sampled 12 auger pits and two test pits upstream from the Golden Gate dam site. The USBR performed sieve analysis, Atterberg limits, specific gravity, and compaction testing at six of the sites. DWR had previously sampled two sites, performing sieve analysis, organic content, and specific gravity tests.

In June of 1999, the DWR Northern District excavated and sampled five test pits upstream from the Golden Gate dam site, in Antelope Valley, as described below.

GG3

The site is adjacent to the streambed. USBR sampling at this location found lean clays, underlain by gravels and 4-inch cobbles.

GG4

The site is in the upper (northern) reaches of Antelope Valley, above any sampling by the USBR.

GG5

The site is located at the upper end of Antelope and adjacent to the streambed.

GG6

The site is located in mid-valley and away from the streambed. USBR sampled nearby and found lean clays underlain by sandy clay and marine sedimentary rocks.

GG7

The site is in the lower reach of Antelope Valley, in the footprint of the proposed upstream alignment of Golden Gate dam. This site will yield information on the quality and suitability of the stripping material for use in dam construction.

Previously, the USBR sampled 13 auger pits in the valley upstream of the Sites dam site. The Bureau performed sieve analysis, Atterberg limits, specific gravity, and compaction testing at three of those sites (USBR documentation did not include a list of the testing standards used). In spring 1998, DWR sampled two sites near the proposed Sites Dam, performing sieve analysis, organic content and specific gravity tests.

In June of 1999, Northern District excavated and sampled seven test pits in the valley upstream of the Sites dam site, as described below.

SC4

The site is lower (downstream) in the borrow area (at the confluence of the south and west branches of the valley), and adjacent to the streambed. USBR sampling here found lean clay and sandy clay.

SC5

The site is approximately in the middle of the south branch of the valley and is not adjacent to streambeds. The USBR performed testing at this site and found lean clay, sandy clay, underlain by interbeded claystone and siltstone.

SC6

This site is in the south branch, further south than sampling the USBR performed. This site is adjacent to the streambed and is near the confluence of multiple drainages.

SC7

The site is located at the southern end of the northwestern branch and adjacent to the Stone Corral Creek streambed.

SC8

The site is located in the upper portion of the northwestern branch and away from the Stone Corral Creek streambed. USBR off-stream sampling in this branch found lean clays underlain by sandy clay and marine sedimentary rocks.

SC9

The site is located adjacent to Stone Corral Creek near the confluence of the two branches of the valley.

SC10

The site is located in the middle of the south valley, adjacent to the streambed.

3.3 TESTS PERFORMED TO DATE

From April to December 1999, the following tests were performed on selected samples.

3.3.1 Rockfill/Riprap

- Rock Compression, Moduli of Elasticity (ASTM D-3148)
- Splitting Tensile Strength (ASTM D-3967)
- Wet-Dry Durability of Rip-Rap (ASTM D-5313) – on-going

3.3.2 Concrete Aggregates

- Bulk Density and Voids in Aggregate (ASTM C-29)
- Test for Organic Impurities in Fine Aggregate (ASTM C-40)
- Sieve Analysis of Fine and Coarse Aggregate (ASTM C-136)
- Specific Gravity and Absorption of Coarse Aggregate (ASTM C-127)
- Specific Gravity and Absorption of Fine Aggregate (ASTM C-128)

- LA Rattler, Small Size Coarse Aggregate (ASTM C-131)
- Clay Lumps and Friable Particles in Aggregate (ASTM C-142)
- LA Rattler, Large Size Coarse Aggregate (ASTM C-535)

3.3.3 Core and Random Zone Materials

Classification testing including mechanical analysis and Atterberg Limits was performed on all samples.

Further testing is ongoing on two composite samples each sample representative of material found in the valleys upstream from the Golden Gate and Sites dam sites. The composite samples were made with equal portions of all samples excluding the approximate 10% finest and 10% coarsest samples (Table 3.1). Ongoing tests on composite samples include:

- Mechanical (ASTM D-422)
- Atterberg Limits (ASTM D-4318)
- Specific Gravity (ASTM D-854)
- Organic Content (ASTM D-2974)
- Compaction (ASTM D-1557)
- Triaxial (ASTM D-4767)
- Permeability (ASTM D-5084)

3.4 SUMMARY OF TESTING RESULTS TO DATE

3.4.1 Rockfill/Riprap

A summary of the results of the rockfill/riprap testing is shown in Table 3.2. For comparative purposes, the engineering properties of the Venado sandstone determined in previous studies (USBR, 1980) as well as strength characteristics of Oroville and Pyramid rockfill materials are included in Table 3.3. Figure 3.3 provides a graphical representation of rock strength and classification, with two accepted rock classification scales for reference.

A wet/dry test was performed for 45 cycles and resulted in a 0.5% loss of the fresh sandstone sample, and a 0.6% loss of the weathered sample. The wet/dry test results classify the fresh and weathered samples of Venado sandstone as fair to good material for riprap.

3.4.2 Concrete Aggregates

A summary of the results of the aggregate testing is shown in Table 3.4. The gradation analyses for fresh and weathered aggregates from Sites Quarry are shown in Figures 3.4 and 3.5, respectively, with the CALTRANS concrete aggregate gradation envelope added for comparative purposes.

3.4.3 Core and Random Zone Materials

Classification has been determined for all samples and is shown in Table 3.5 and Figures 3.6 through 3.26. Testing on the composite samples is on-going. Tests to determine classification, Atterberg limits, specific gravity, organic content, and compaction have been completed and are summarized in Table 3.6 and Figures 3.27 and 3.28. Tests still to be completed include permeability and shear strength (UU and CUE).

The completed tests show the fine grained material sources to be predominately lean clay with some fat clay. The composite samples must be tested for strength and permeability.

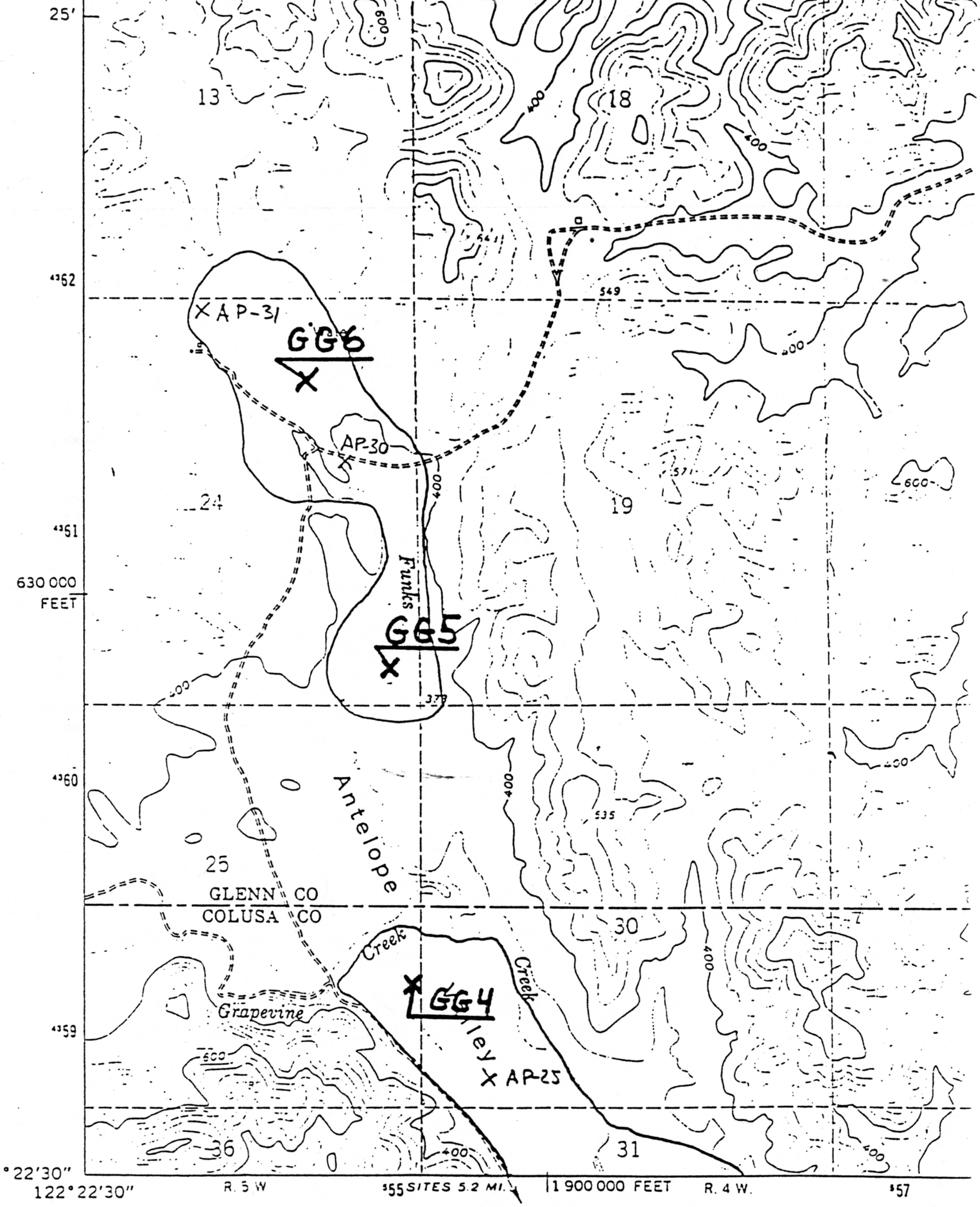
3.5 DISCUSSION OF RESULTS

The Sites quarry material has sufficient strength and durability characteristics for use as rockfill and riprap, but degradation due to weathering of the exposed rock should be expected during the life of the structure and may require selective replacement.

The aggregate testing indicates that both the fresh and weathered sandstone are poor quality materials for use as concrete aggregates. The average loss by the Los Angeles Rattler test was 46 percent and 51 percent, respectively, for the fresh and weathered sandstones. These losses exceed the CALTRANS' (CALTRANS Spec #90-2.02A) 45 percent maximum allowable loss for concrete mix designs, and are borderline with respect to the ACI guidelines for concrete aggregates (ACI-221R) with typical losses of 15 to 50 percent. The Bureau's testing found the soundness of the rock to be poor, further indicating the rock's low quality for use as a concrete aggregate.

The fine-grained material is a lean clay with a large content of fines (over 80% passing the #200 sieve). Published values for the effective strength are approximately $c'=10$ psi and $\phi'=25^{\circ}$, and permeability of this type of material is approximately $k=10^{-6}$ cm/sec[4].

Stability analyses for the zoned embankment dams (discussed in Chapters IV and V) were based on assumed strength parameters, not on values determined by this material testing program. The testing program and the stability analyses were carried out concurrently, so actual materials strengths were not available for use in evaluating embankment stability.



(LODOGA 1:62 500)
1562 IV

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by photogrammetric methods and by planetable surveys 1958. Aerial photographs taken 1957

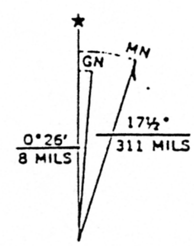
Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 2
1000-meter Universal Transverse Mercator grid ticks, zone 10, shown in blue

Dashed land lines indicate approximate locations

Unchecked elevations are shown in brown

Map photoinspected 1973

No major culture or drainage changes observed



UTM GRID AND 1958 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

FIGURE 3.1

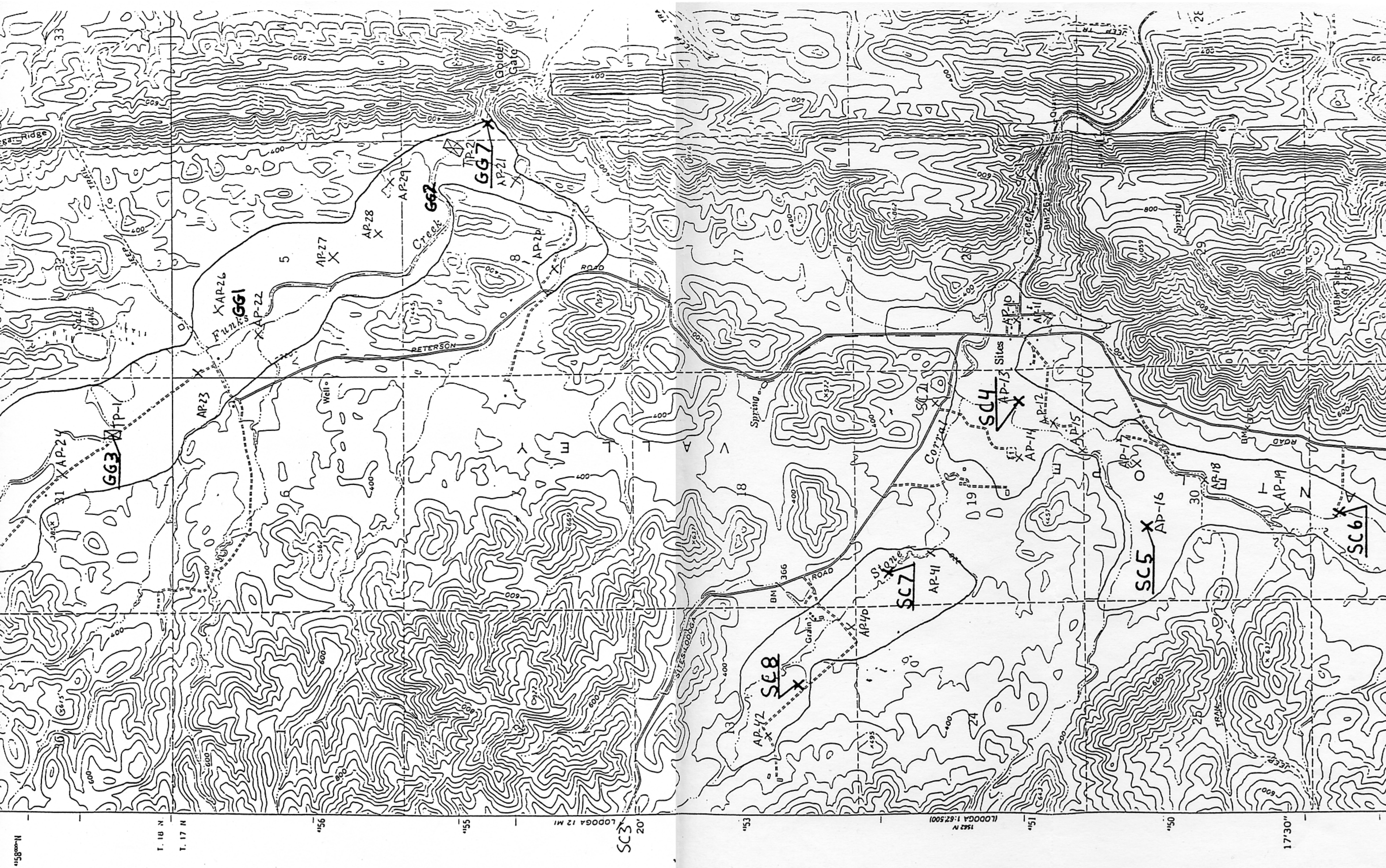
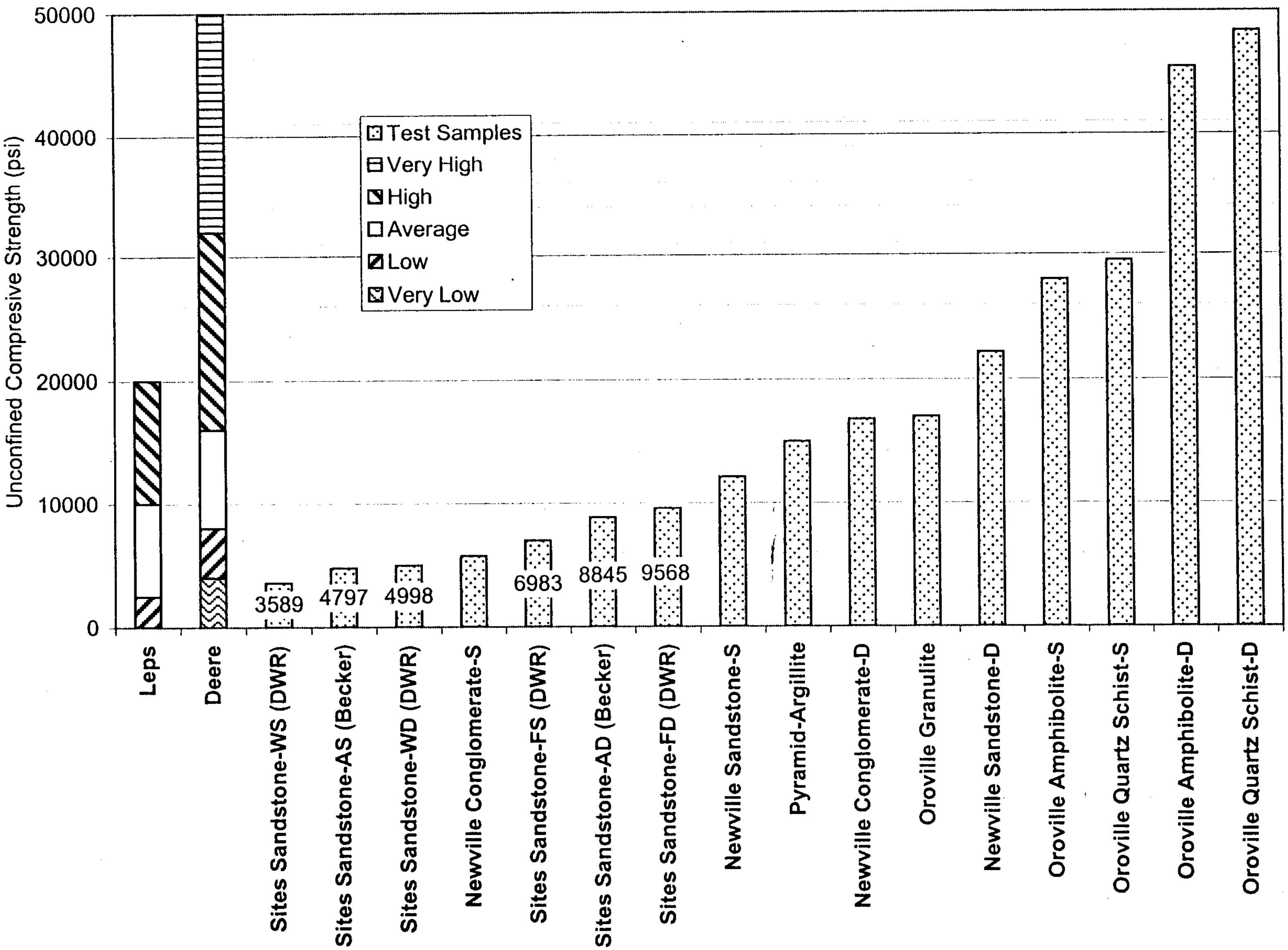

GG1
GG2
GG3
GG7
SC3
SC4
SC5
SC6
SC7
SC8
Golden Gate
Funks
Creek
Stone
Corral
Sites
Spring
Well
PETERSON
ROAD

FIGURE 3.2

Rock Strength and Classification

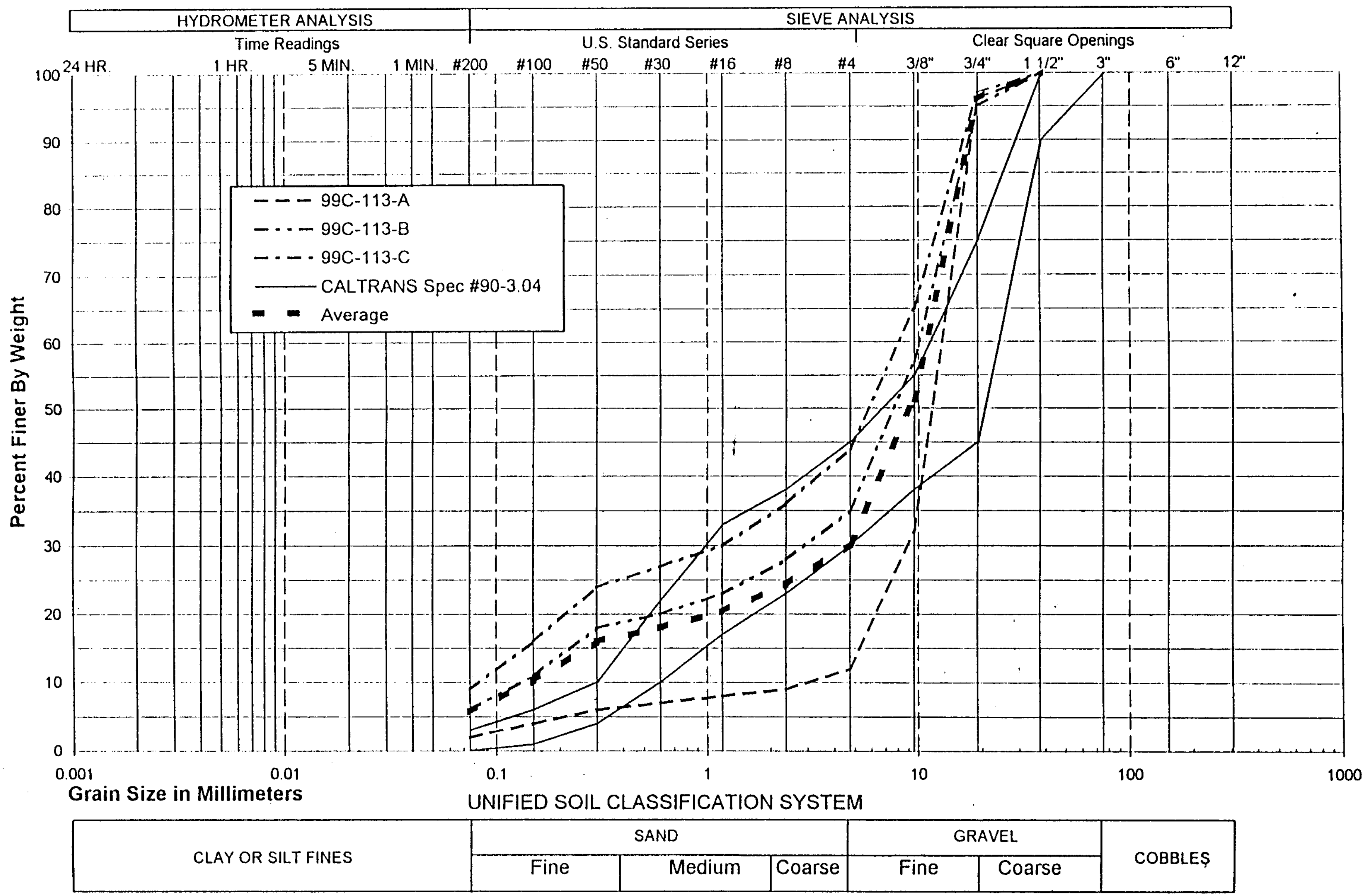


F=Fresh, W=Weathered, A=Average, D=Dry, S=Saturated

FIGURE 3.3

SITES RESERVOIR

Sites Quarry Aggregates - Fresh



SITES RESERVOIR

Sites Quarry Aggregates - Weathered

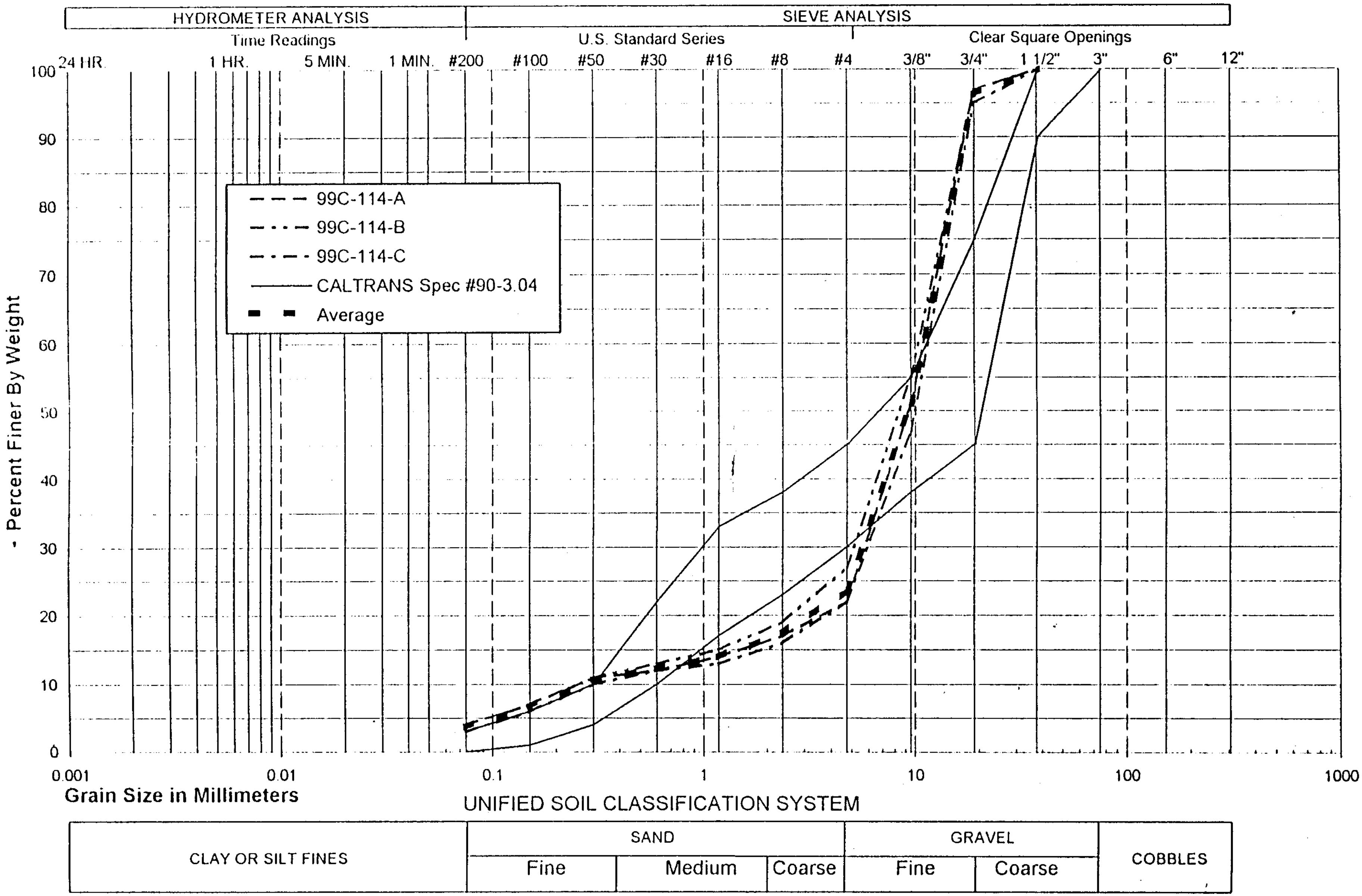


FIGURE 3-5

SITES RESERVOIR

Proposed Core Material (Golden Gate)

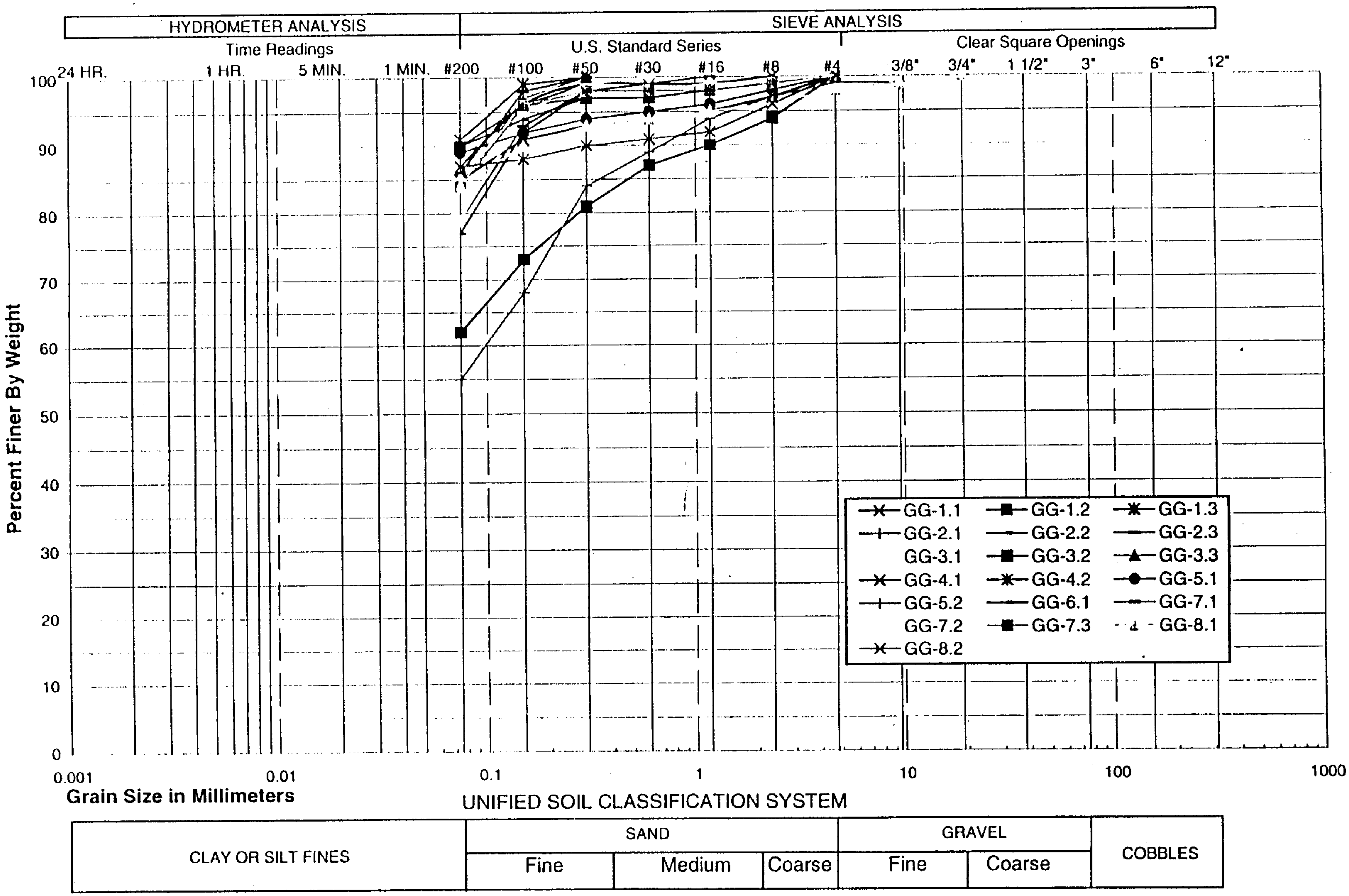


Figure 3.6

SITES RESERVOIR
PLASTICITY CHART
GOLDEN GATE

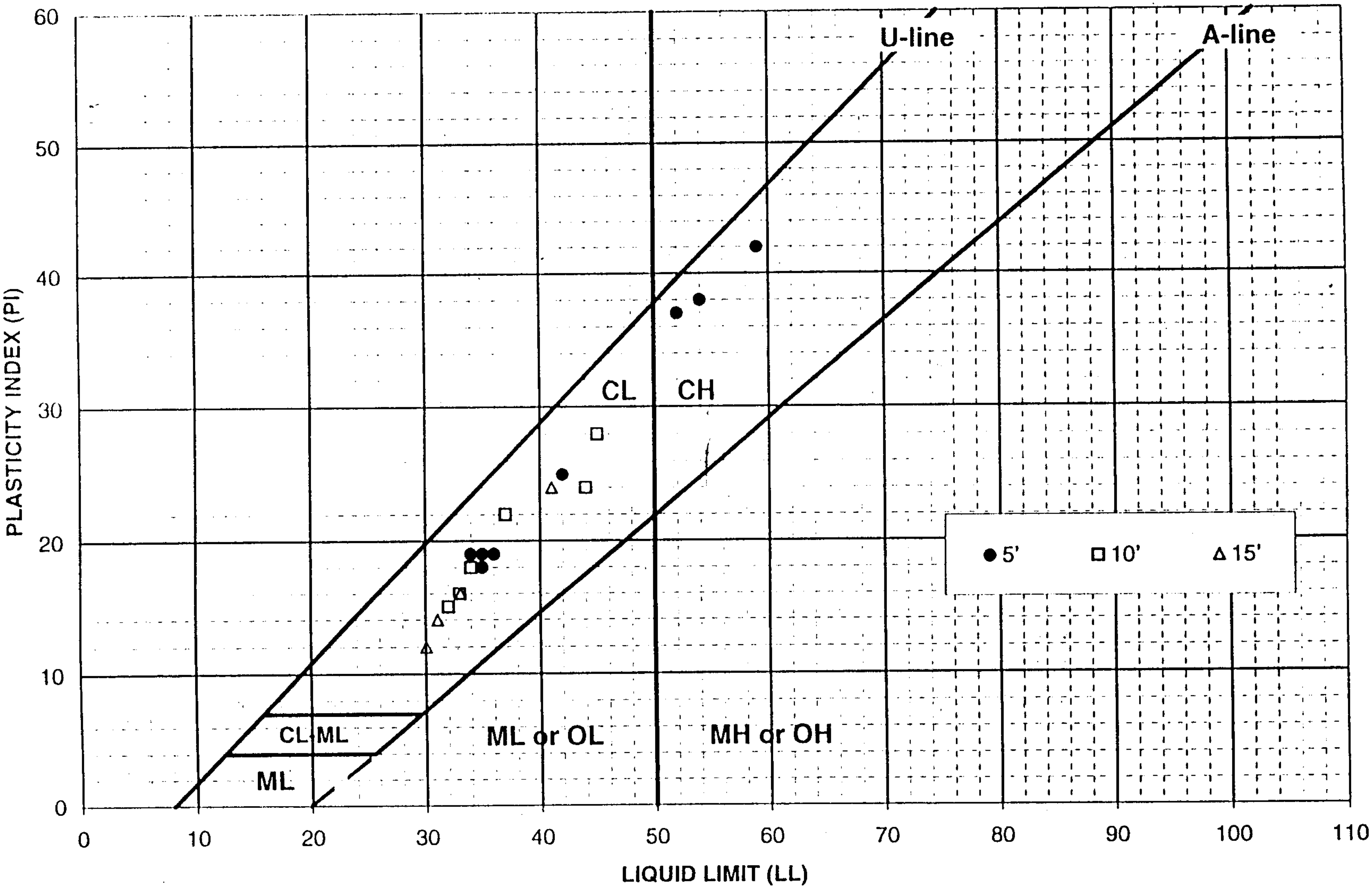


Figure 3.7

SITES RESERVOIR

Proposed Core Material (Golden Gate 5')

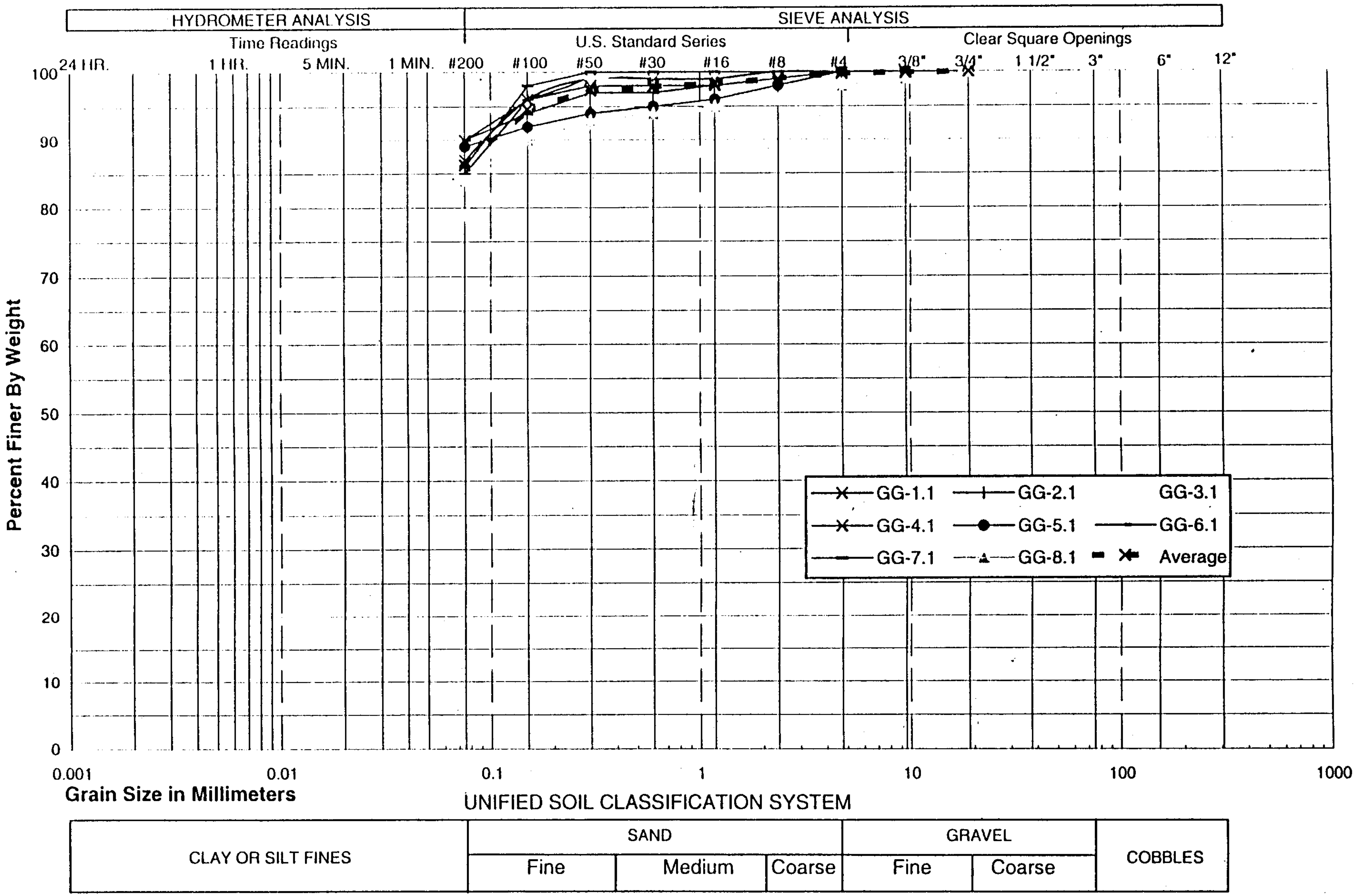


Figure 3.8

SITES RESERVOIR

Proposed Core Material (Golden Gate 10')

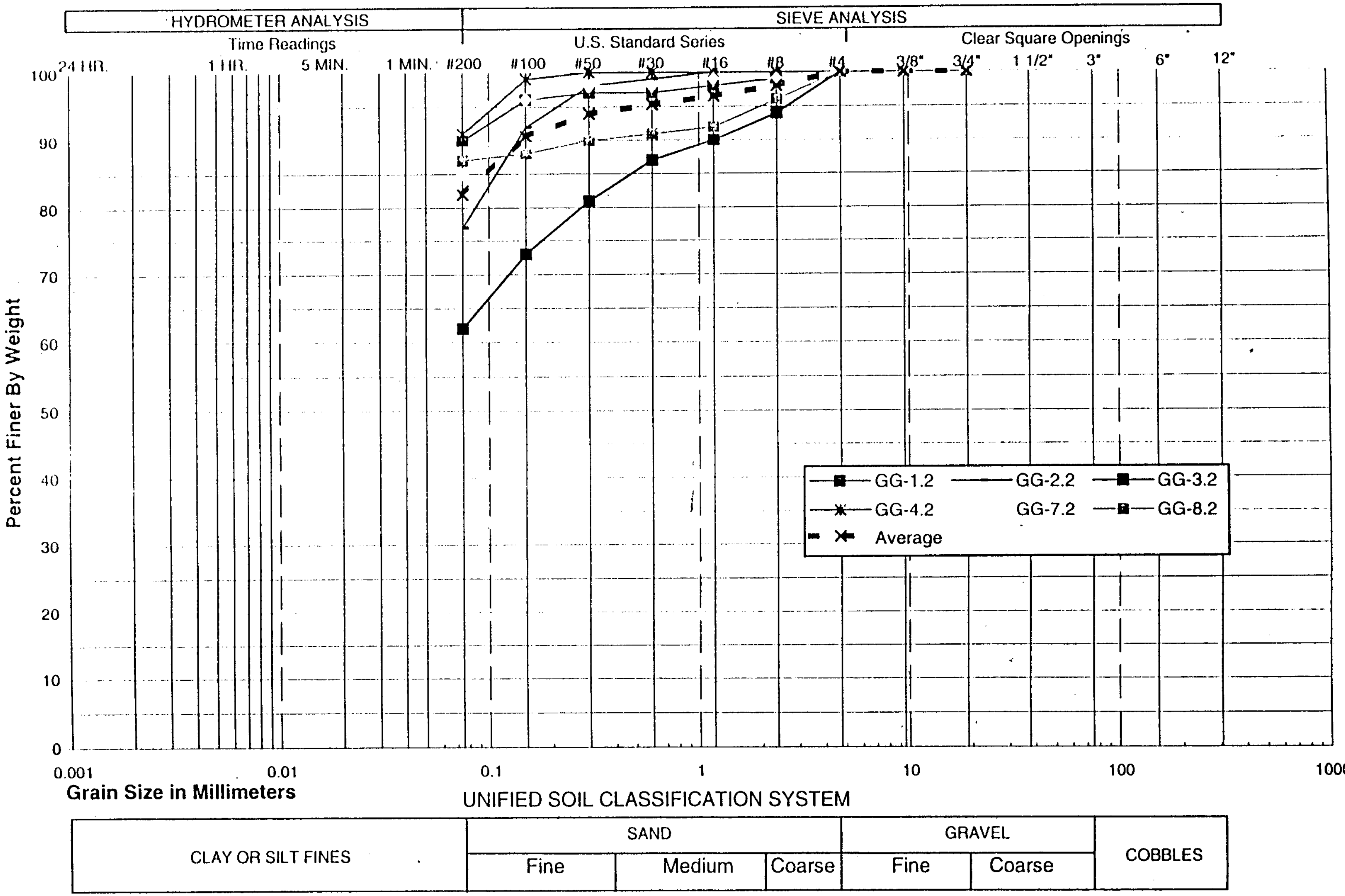
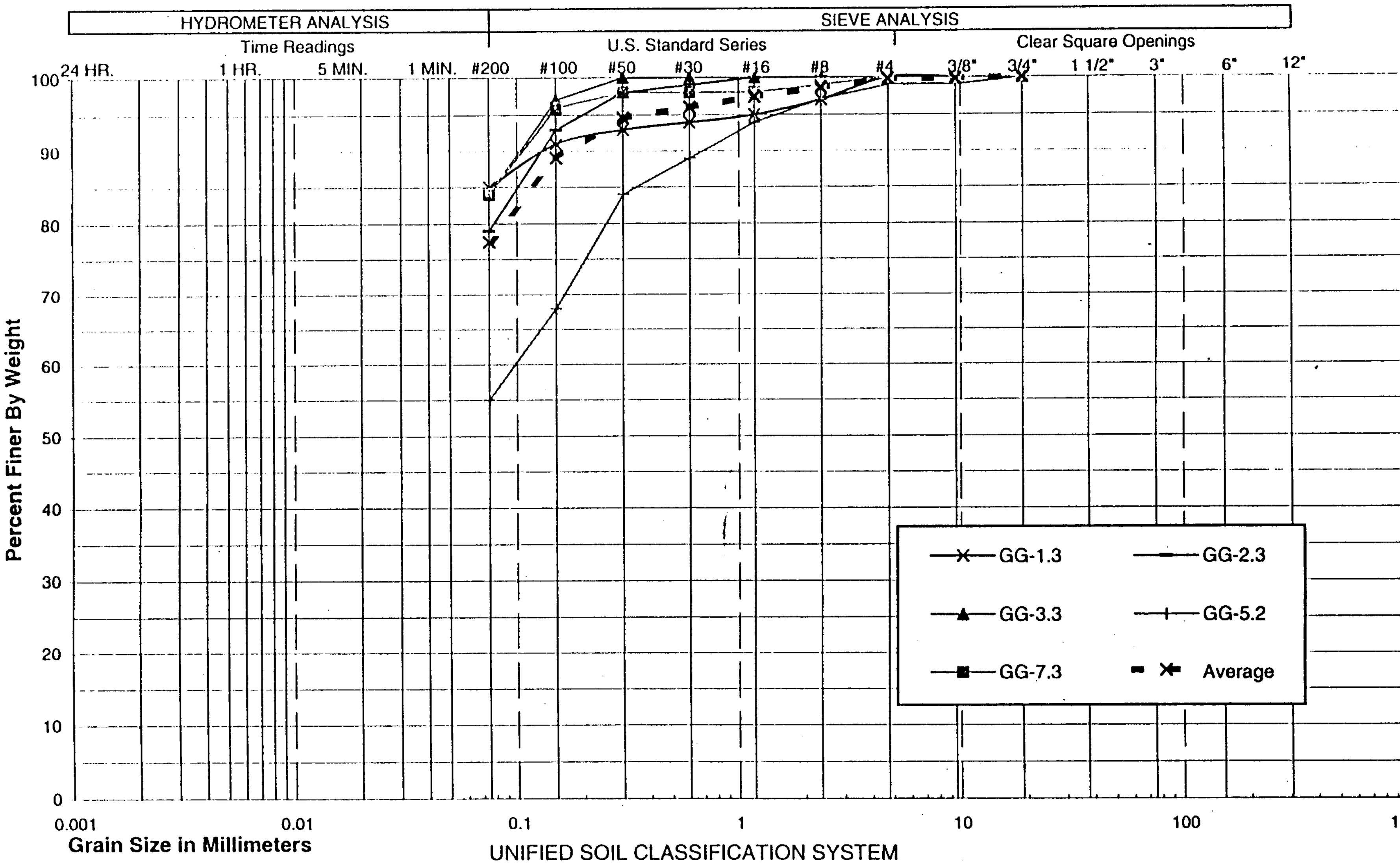


Figure 3.9

SITES RESERVOIR

Proposed Core Material (Golden Gate 15')



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY OR SILT FINES	SAND			GRAVEL		COBBLES
	Fine	Medium	Coarse	Fine	Coarse	

Figure 3.10

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-3)

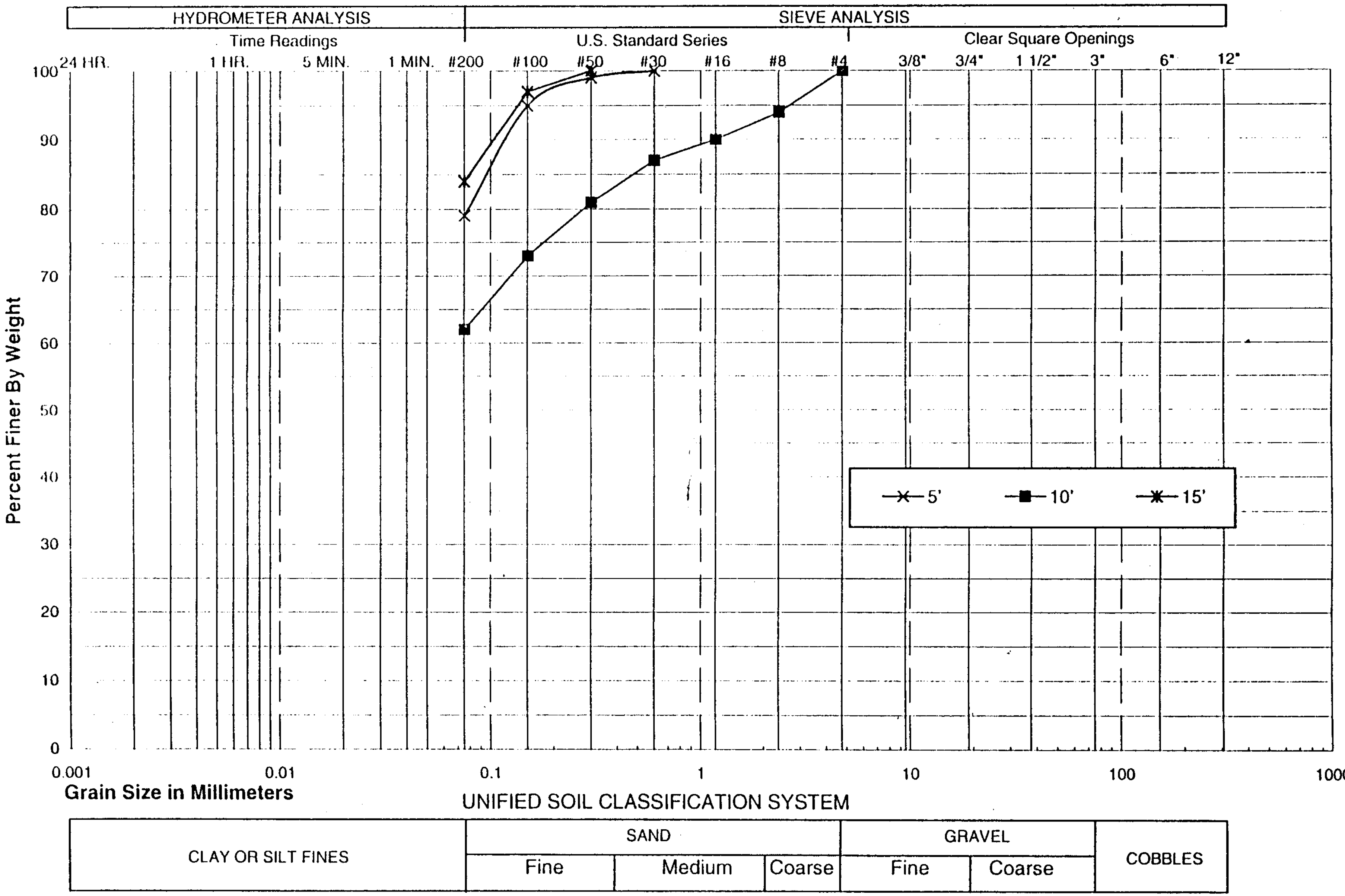


Figure 3.11

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-4)

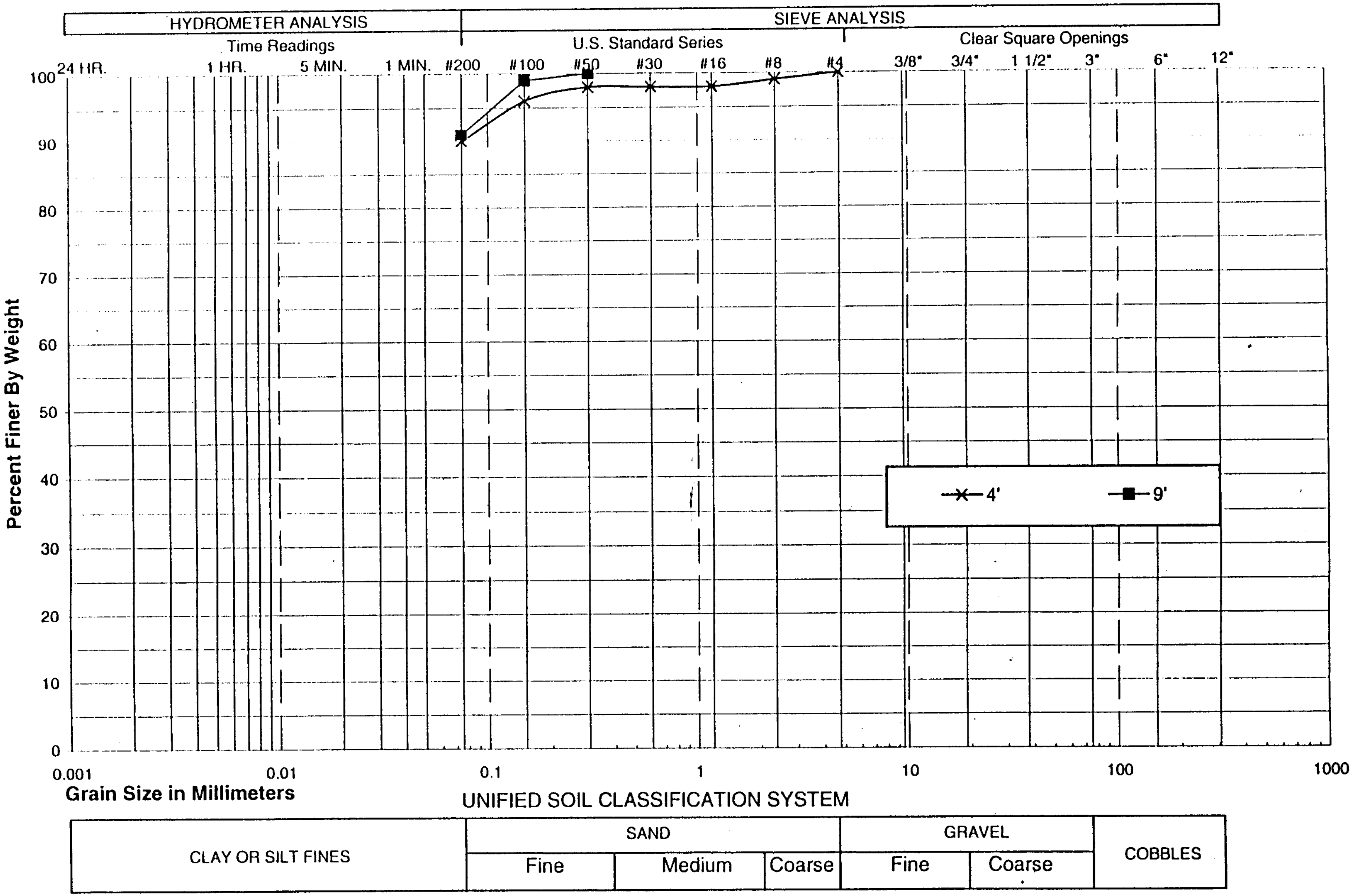


Figure 3.12

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-5)

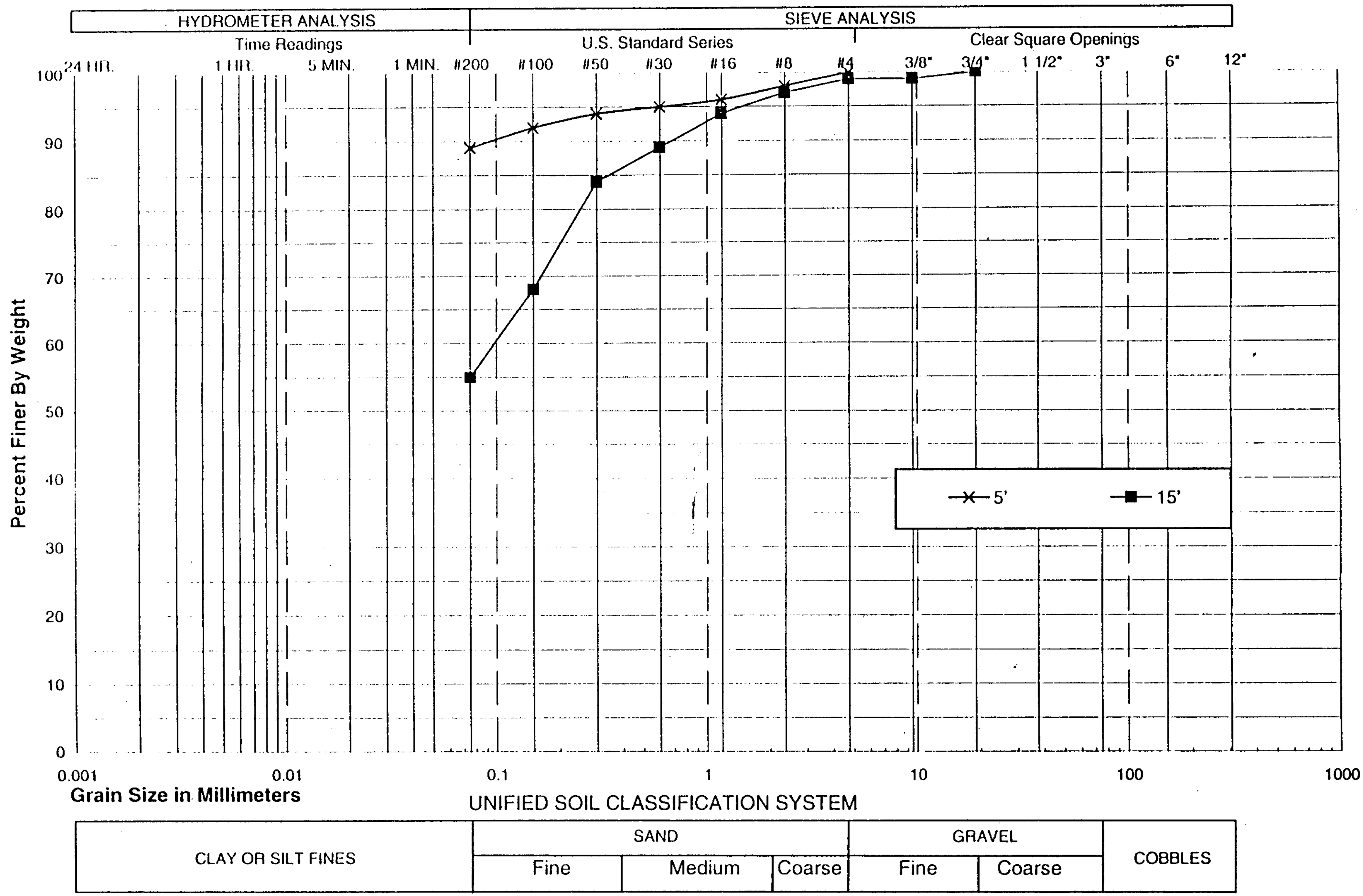


Figure 3.13

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-6)

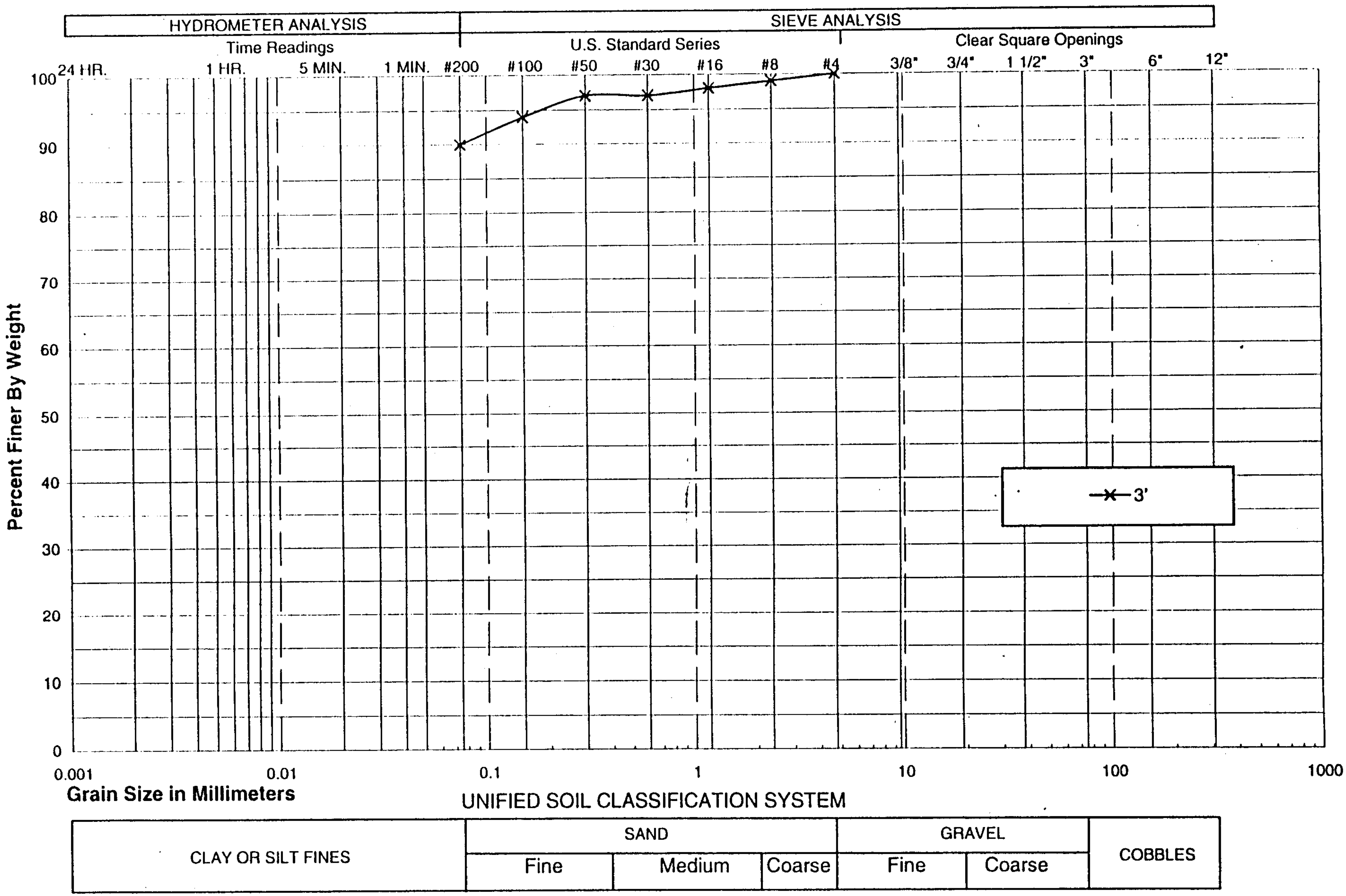


Figure 3.14

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-7)

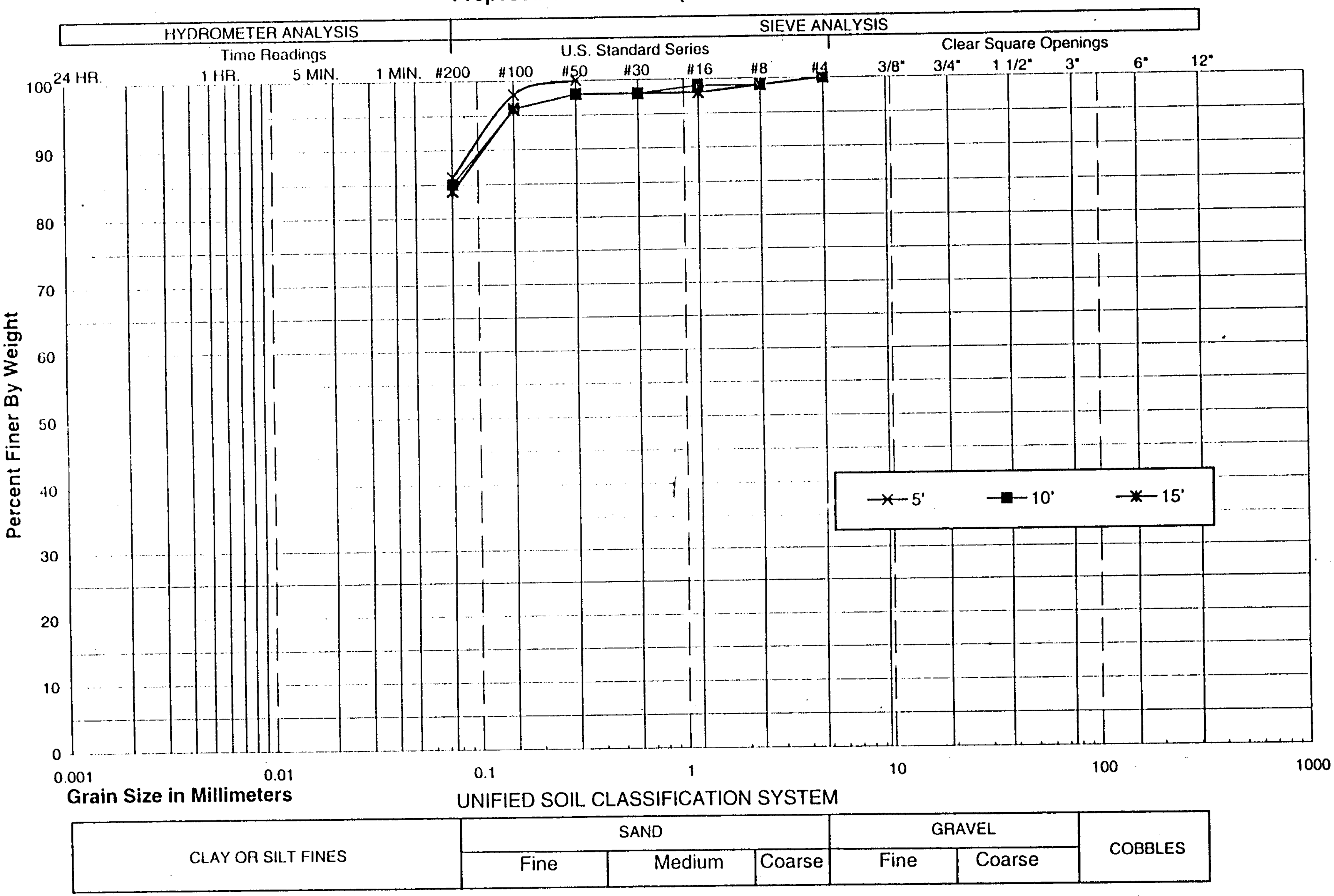


Figure 3.15

SITES RESERVOIR

Proposed Core Material (Golden Gate GG-8)

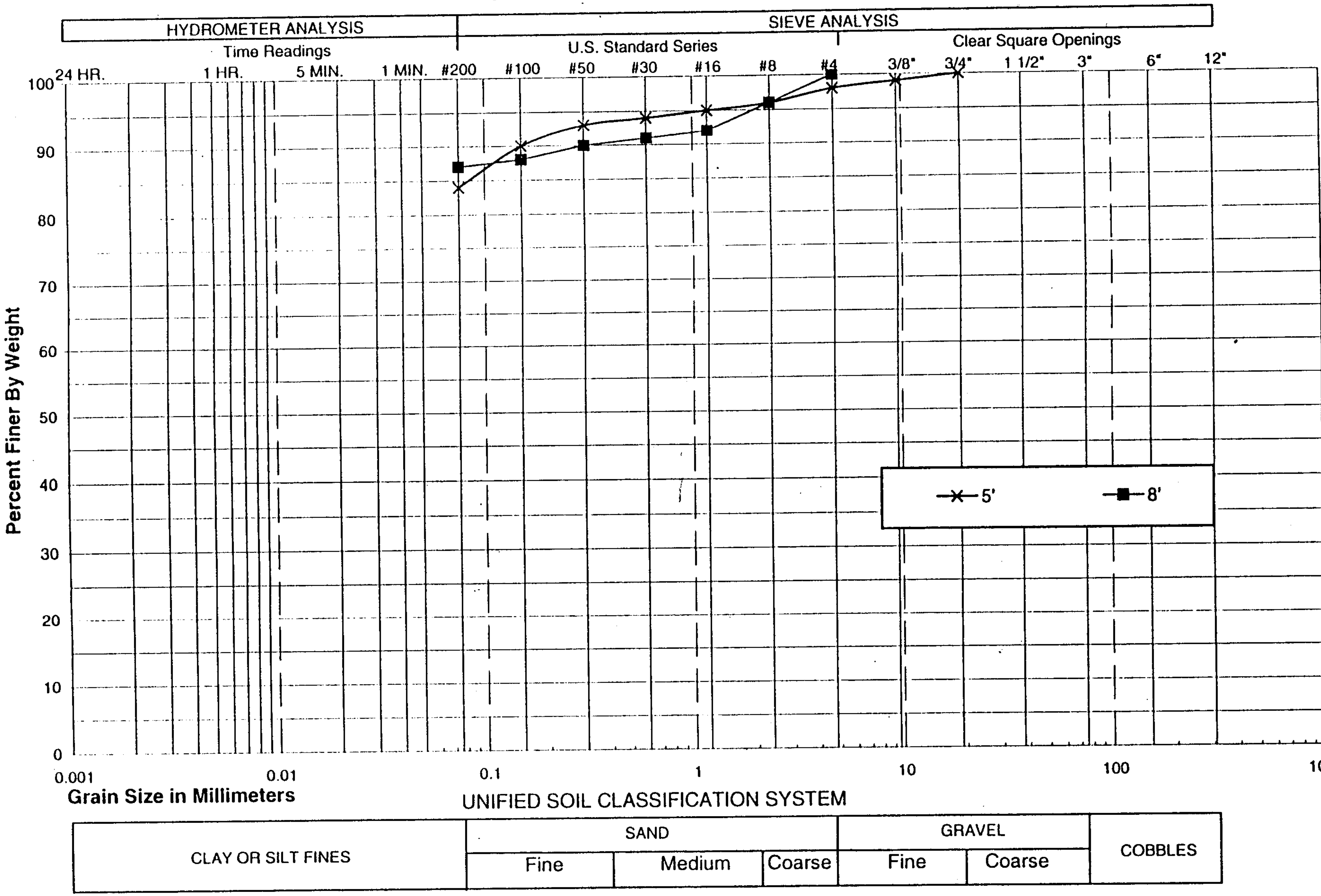


Figure 3.16

SITES RESERVOIR

Proposed Core Material (Sites-Colusa)

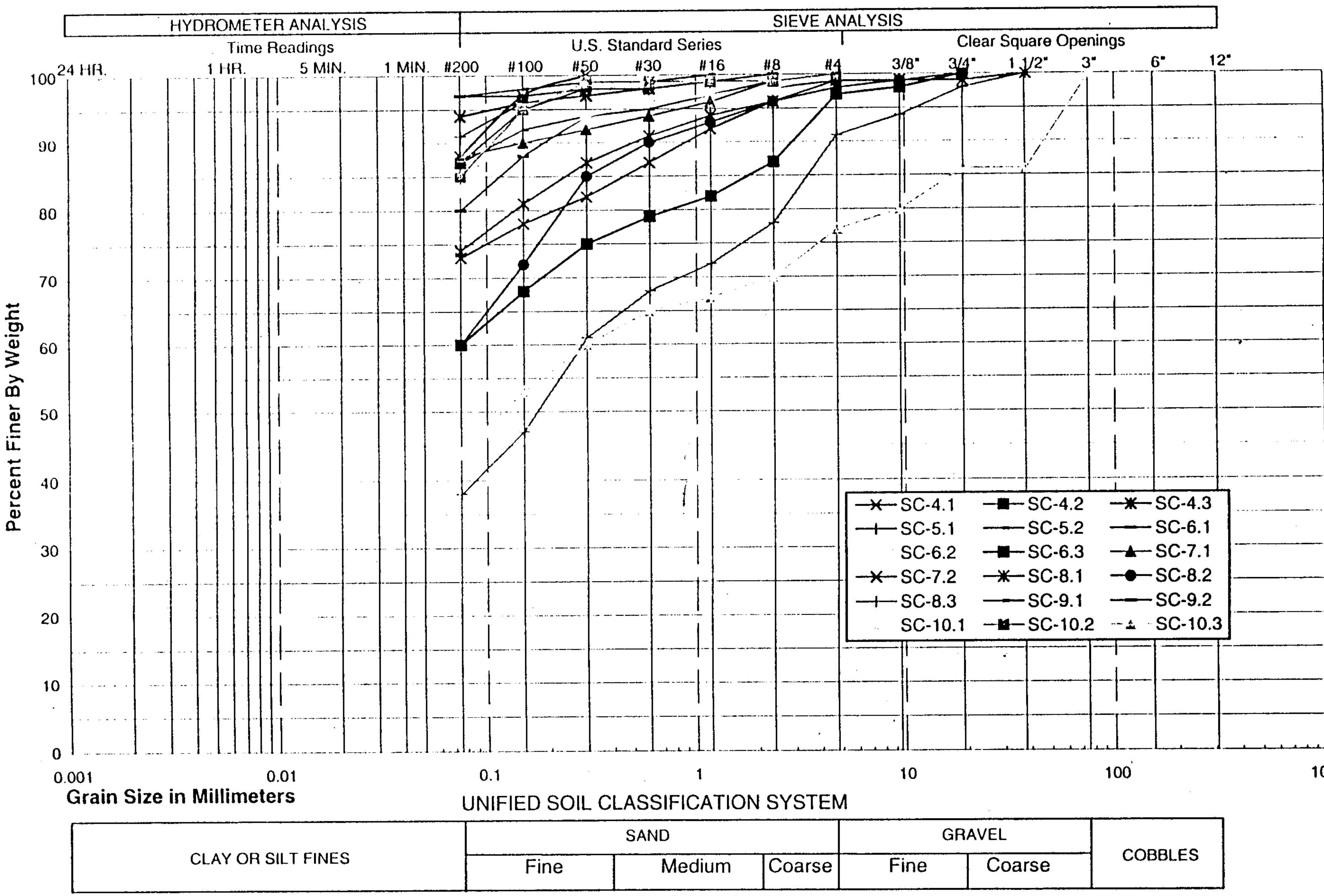


Figure 3.17

SITES RESERVOIR
PLASTICITY CHART
SITES-COLUSA

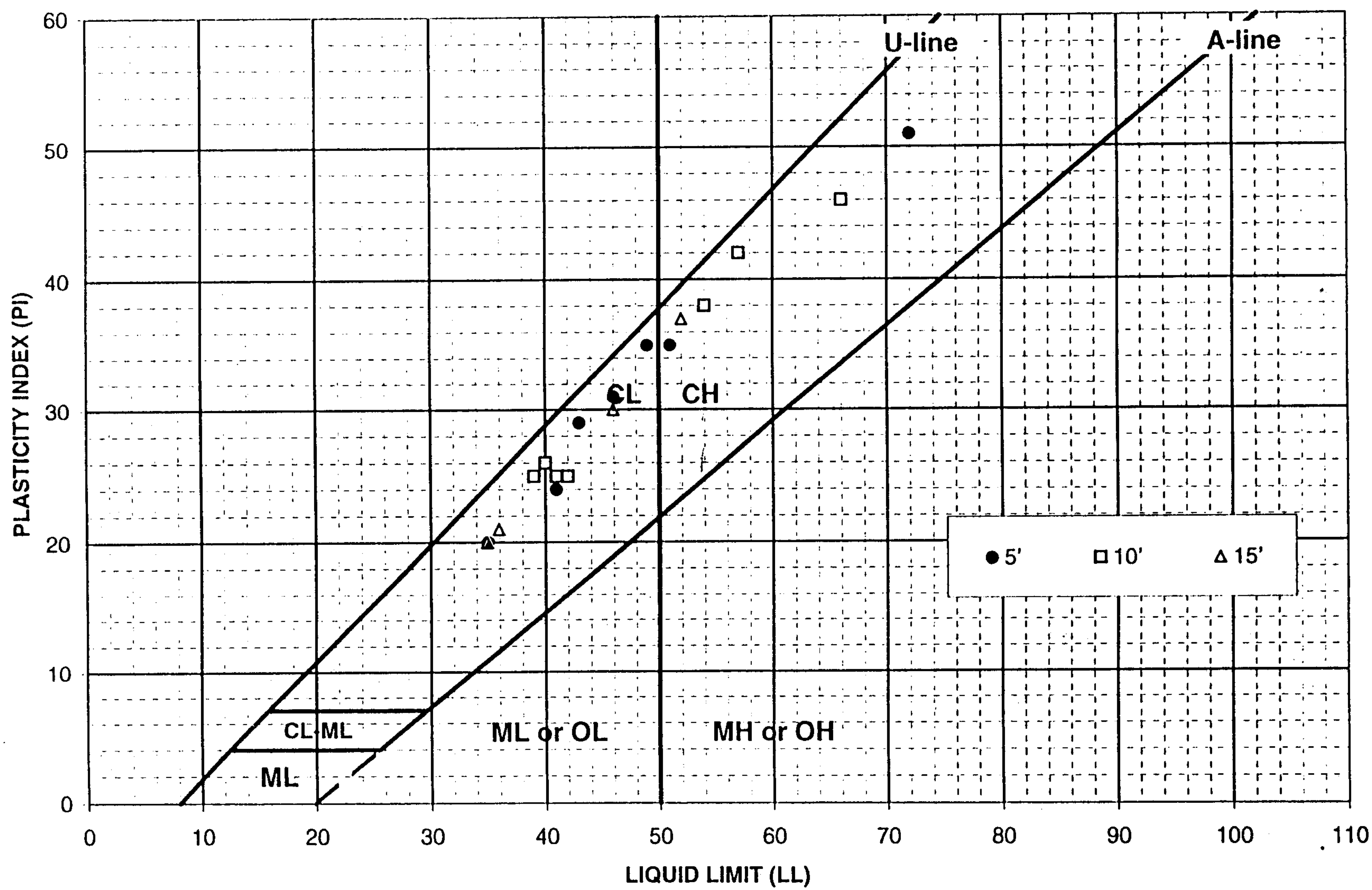


Figure 3.18

SITES RESERVOIR

Proposed Core Material (Sites-Colusa 5')

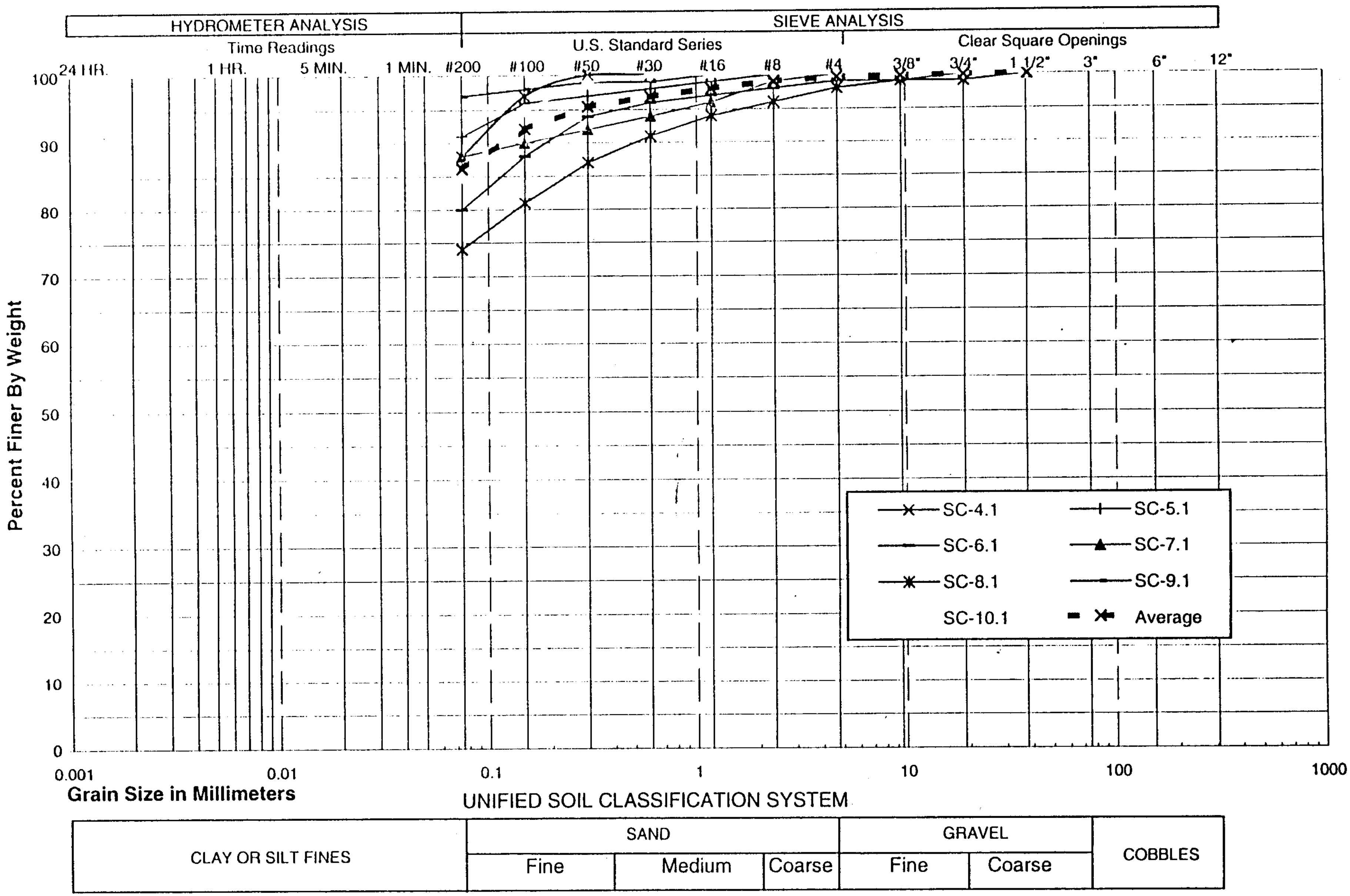


Figure 3.19

SITES RESERVOIR

Proposed Core Material (Sites-Colusa 10')

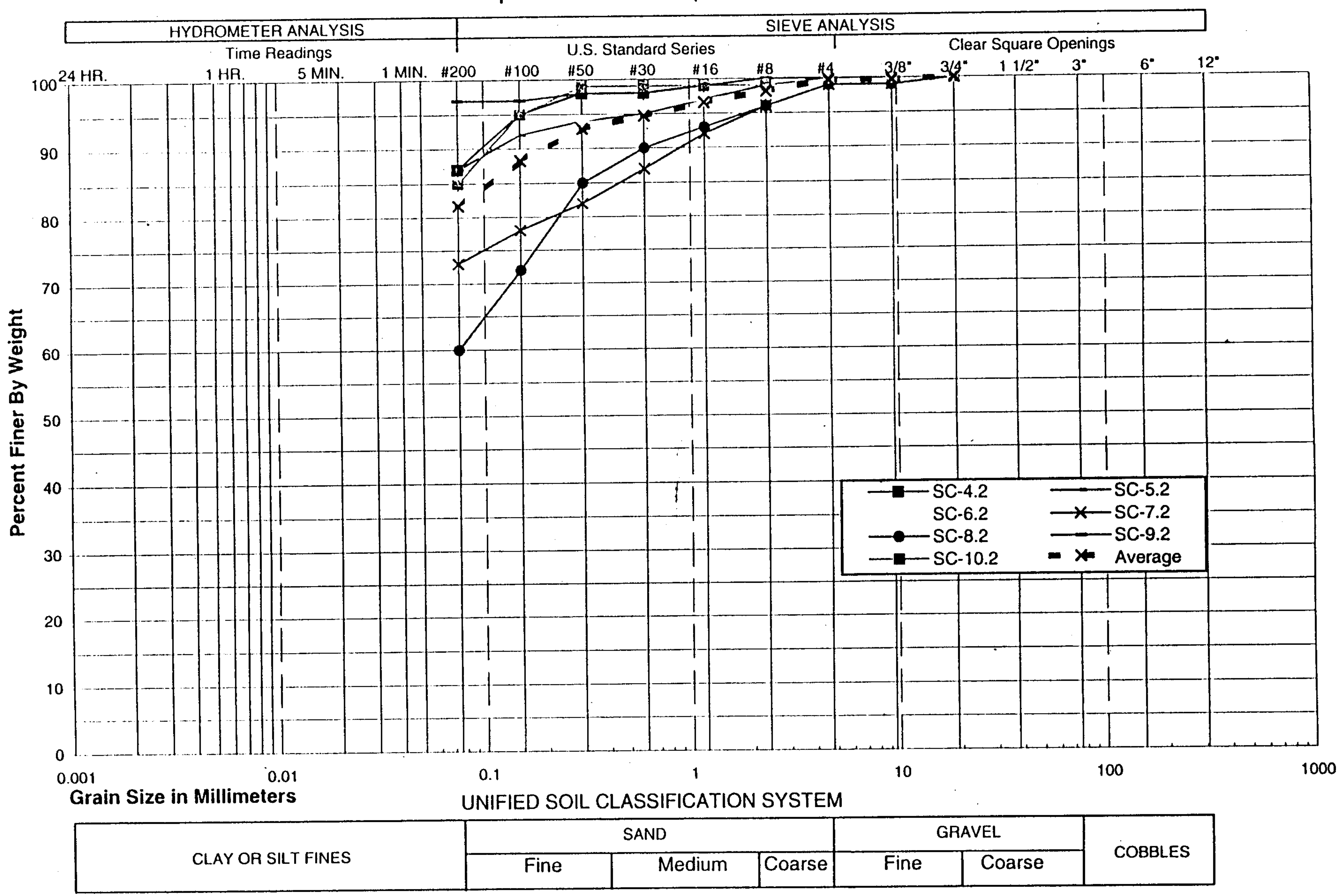


Figure 3.20

SITES RESERVOIR

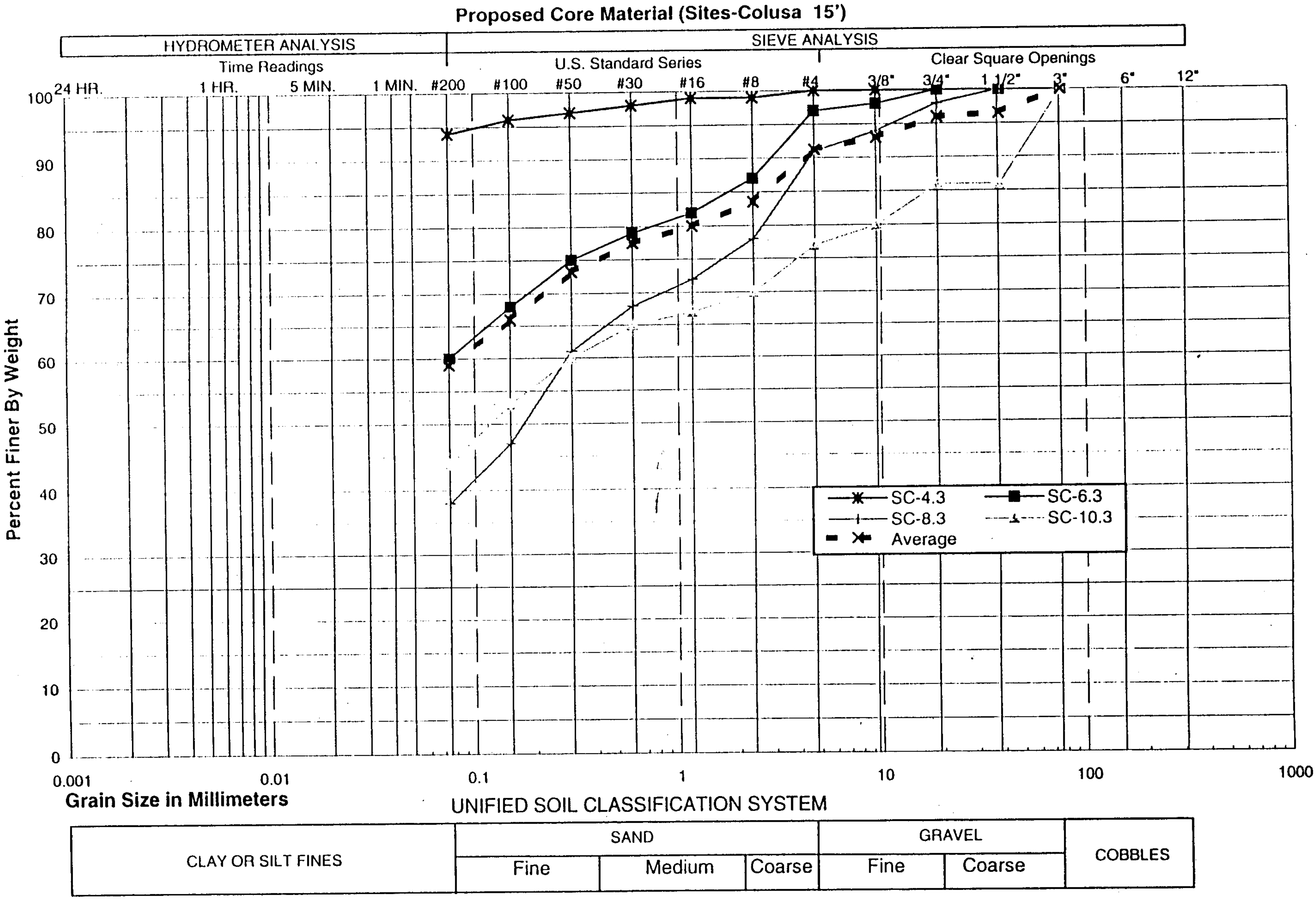


Figure 3.21

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-4)

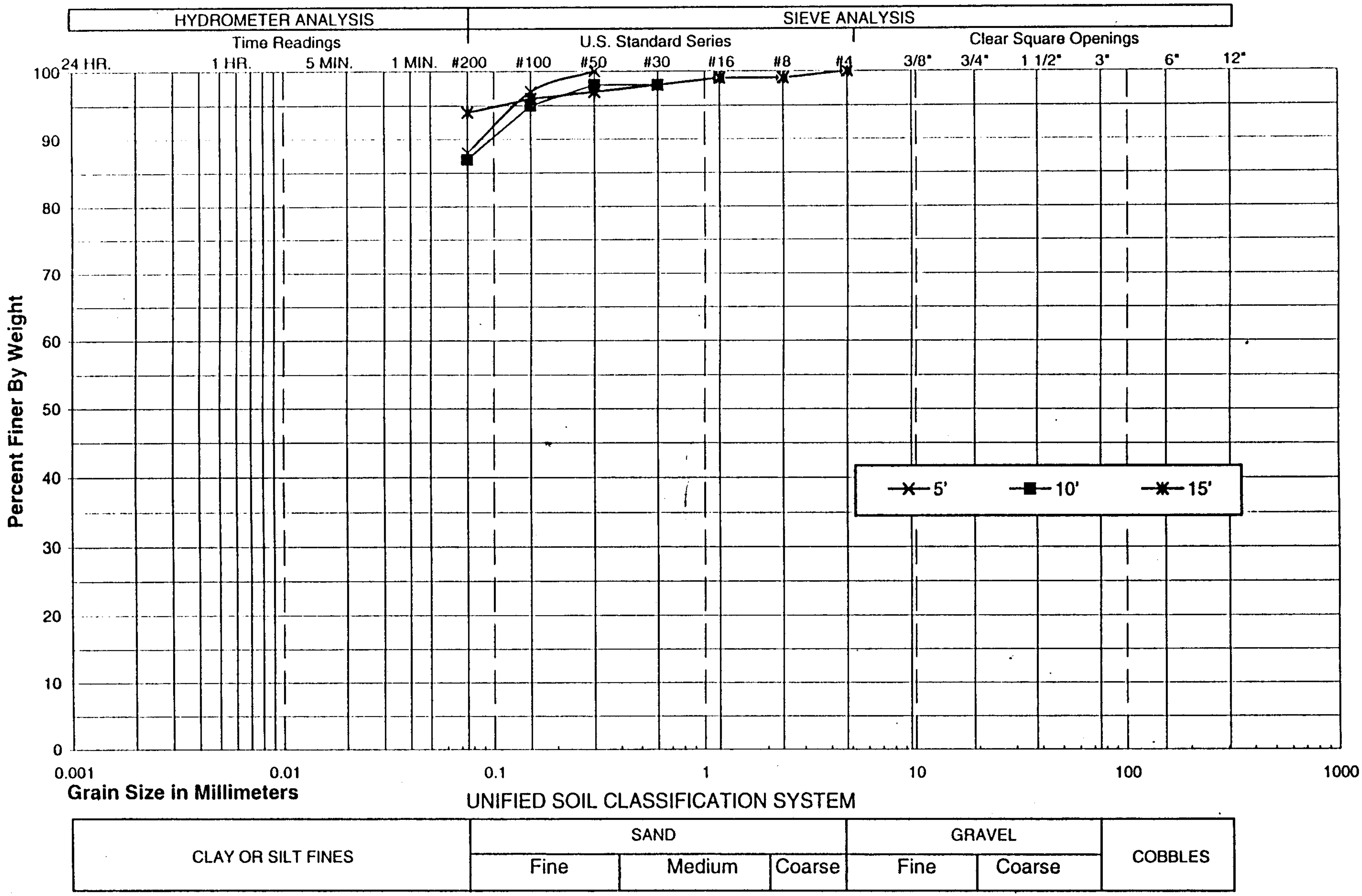
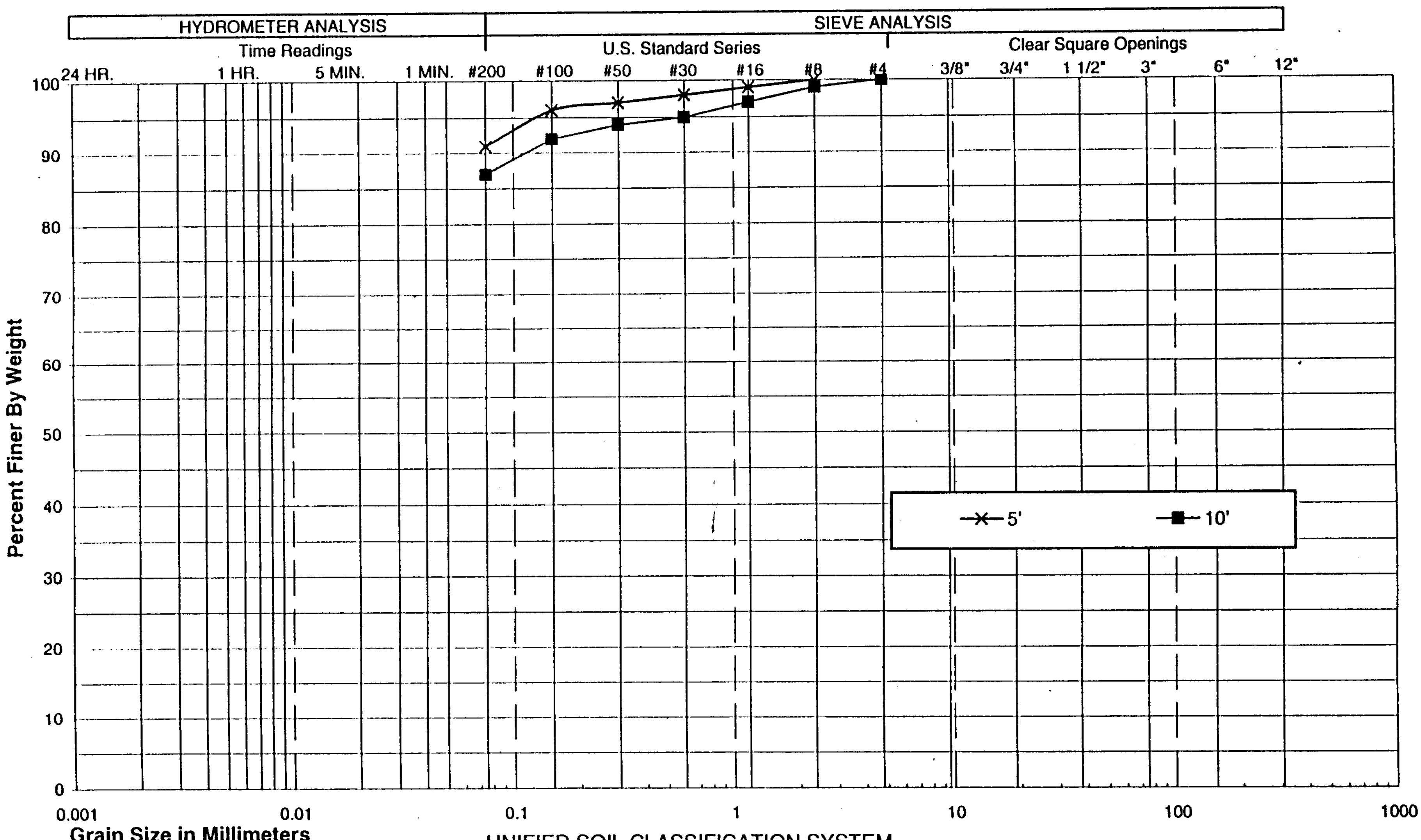


Figure 3.22

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-5)



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY OR SILT FINES	SAND			GRAVEL		COBBLES
	Fine	Medium	Coarse	Fine	Coarse	

Figure 3.23

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-6)

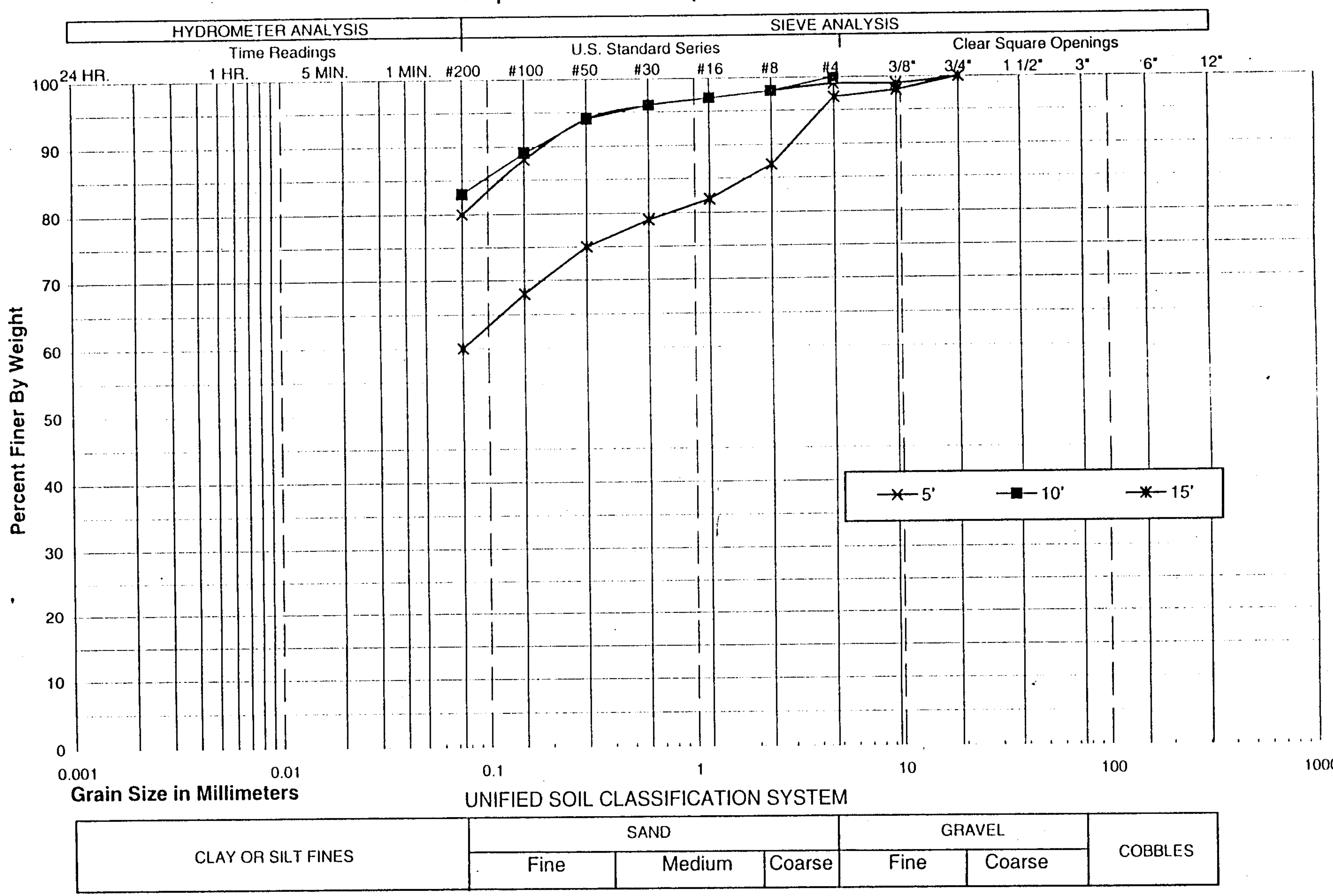
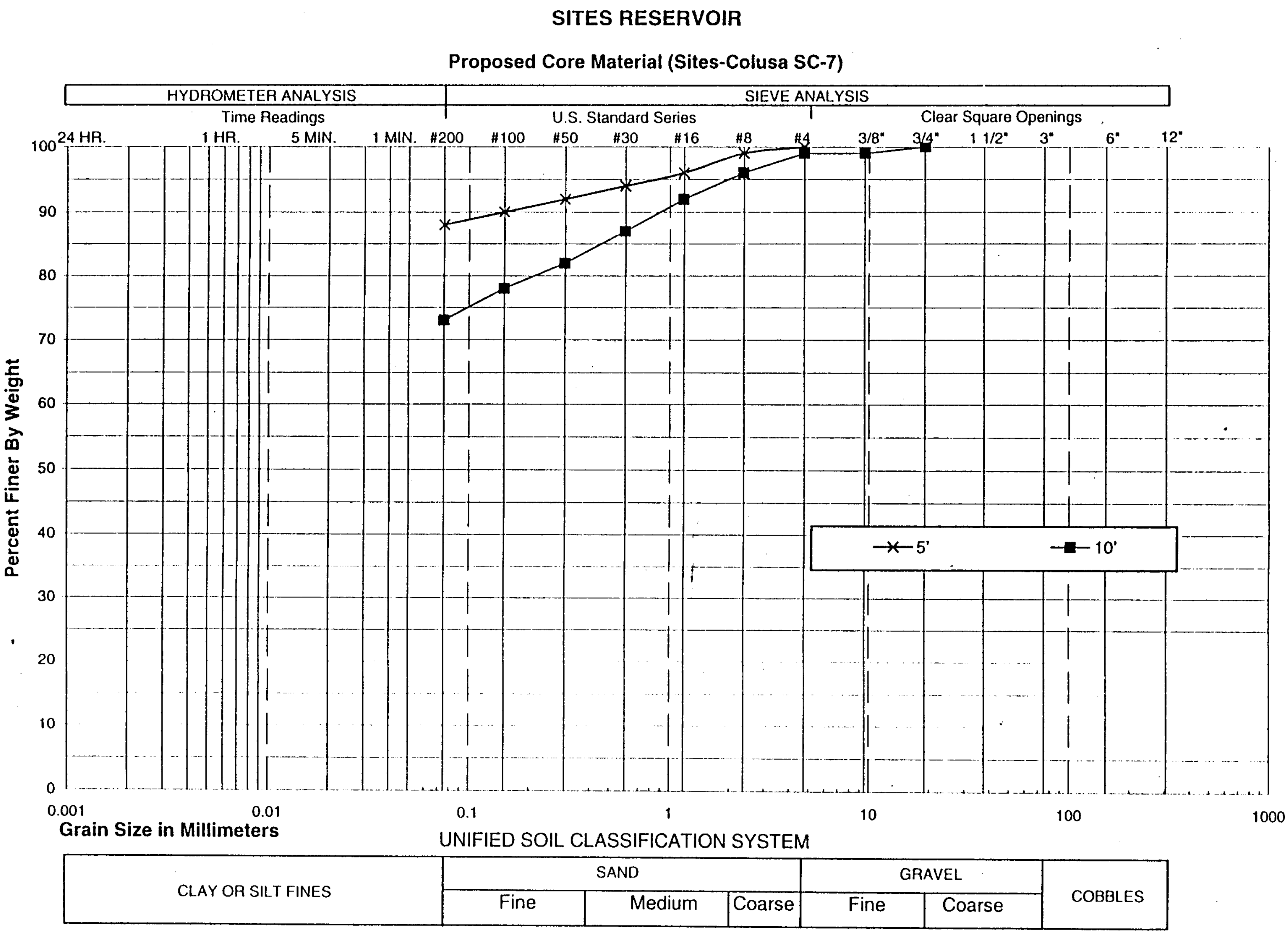


Figure 3.24

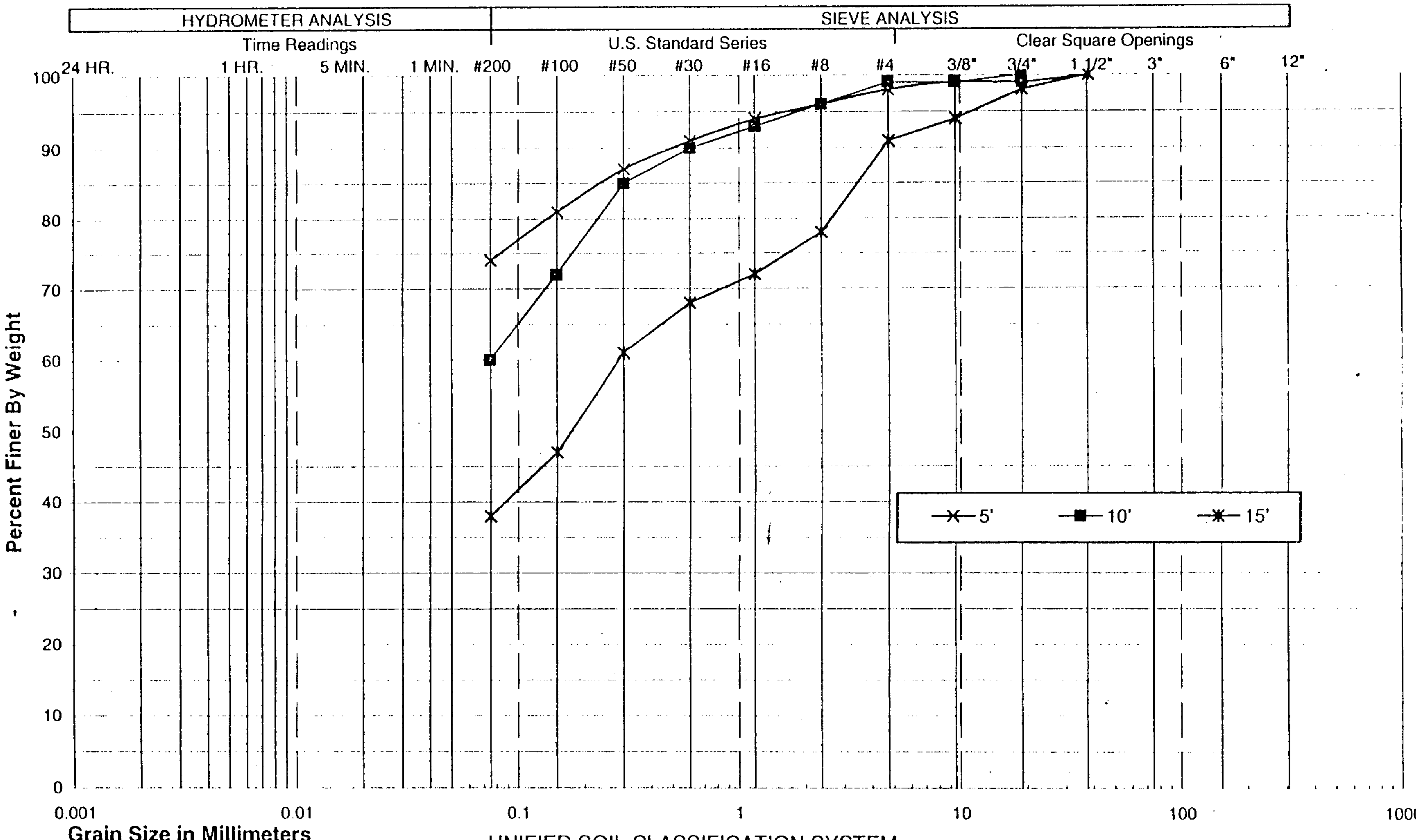


SITES RESERVOIR
Proposed Core Material (Sites-Colusa SC-7)
HYDROMETER ANALYSIS
SIEVE ANALYSIS
Time Readings
U.S. Standard Series
Clear Square Openings
24 HR.
1 HR.
5 MIN.
1 MIN.
#200
#100
#50
#30
#16
#8
#4
3/8"
3/4"
1 1/2"
3"
6"
12"
Percent Finer By Weight
100
90
80
70
60
50
40
30
20
10
0
0.001
0.01
0.1
1
10
100
1000
Grain Size in Millimeters
5'
10'
UNIFIED SOIL CLASSIFICATION SYSTEM
CLAY OR SILT FINES
SAND
Fine
Medium
Coarse
GRAVEL
Fine
Coarse
COBBLES

Figure 3.25

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-8)



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY OR SILT FINES	SAND			GRAVEL		COBBLES
	Fine	Medium	Coarse	Fine	Coarse	

Figure 3.26

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-9)

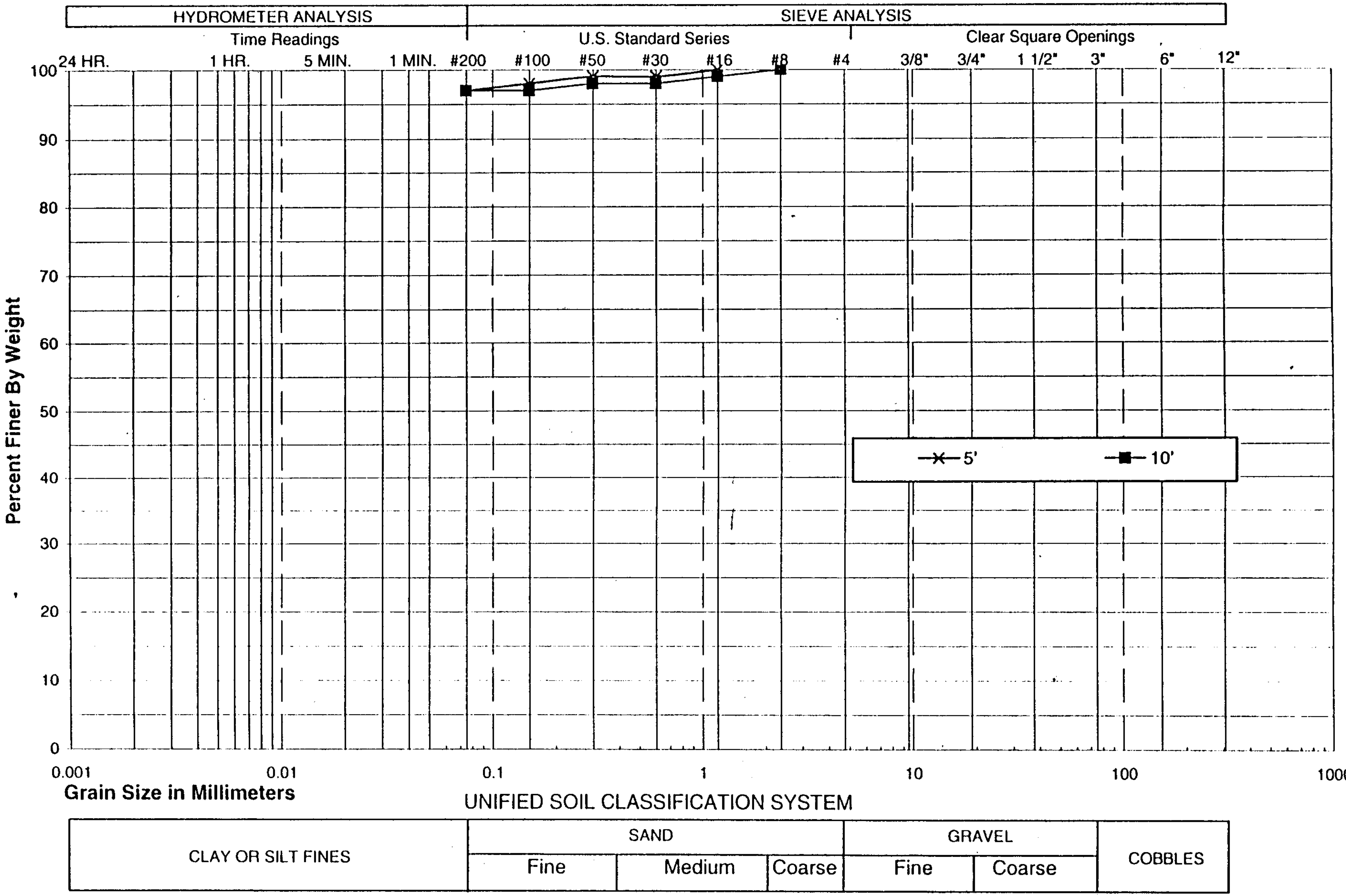


Figure 3.27

SITES RESERVOIR

Proposed Core Material (Sites-Colusa SC-10)

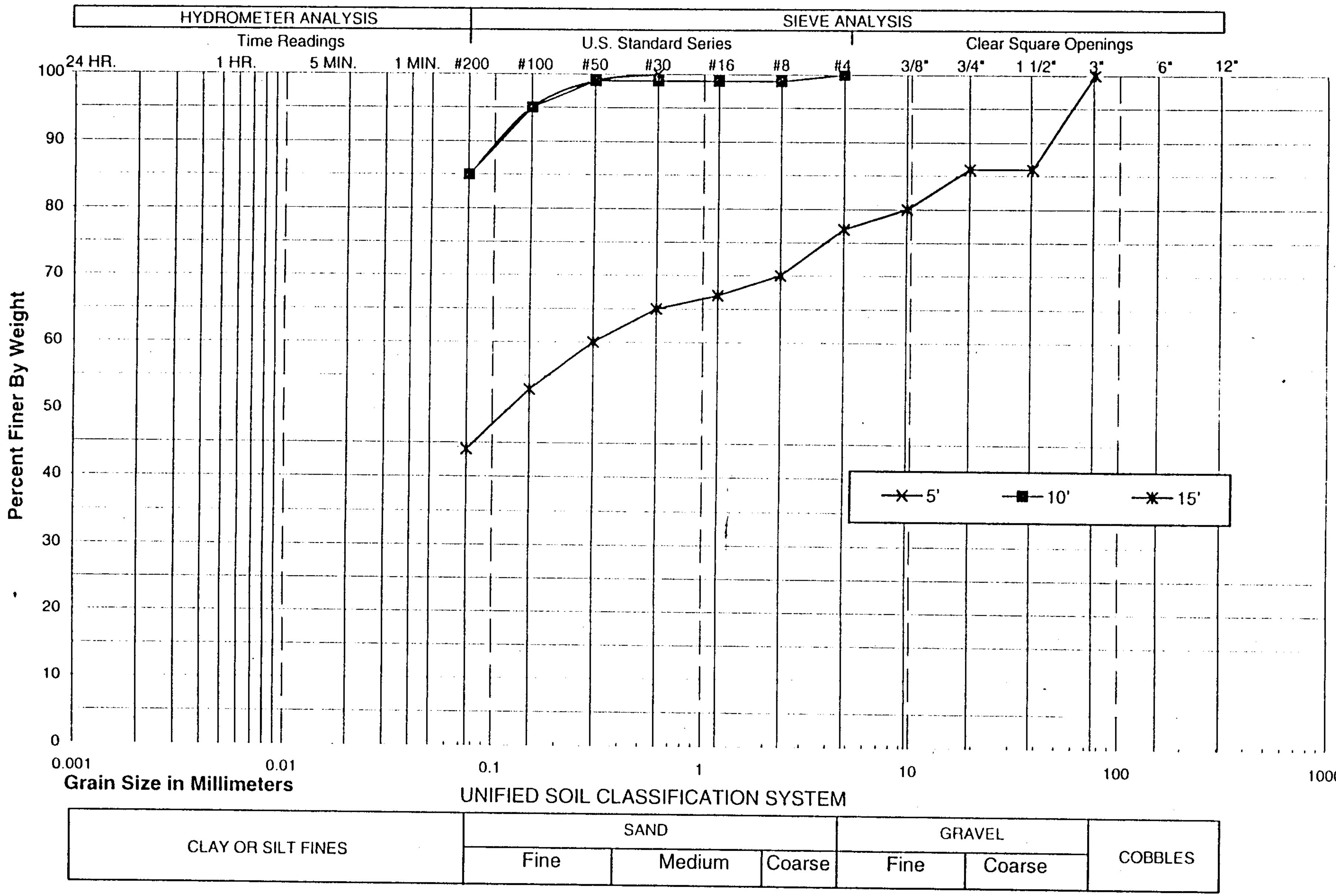


Figure 3.28

SITES RESERVOIR

Proposed Core Material (Composite Samples)

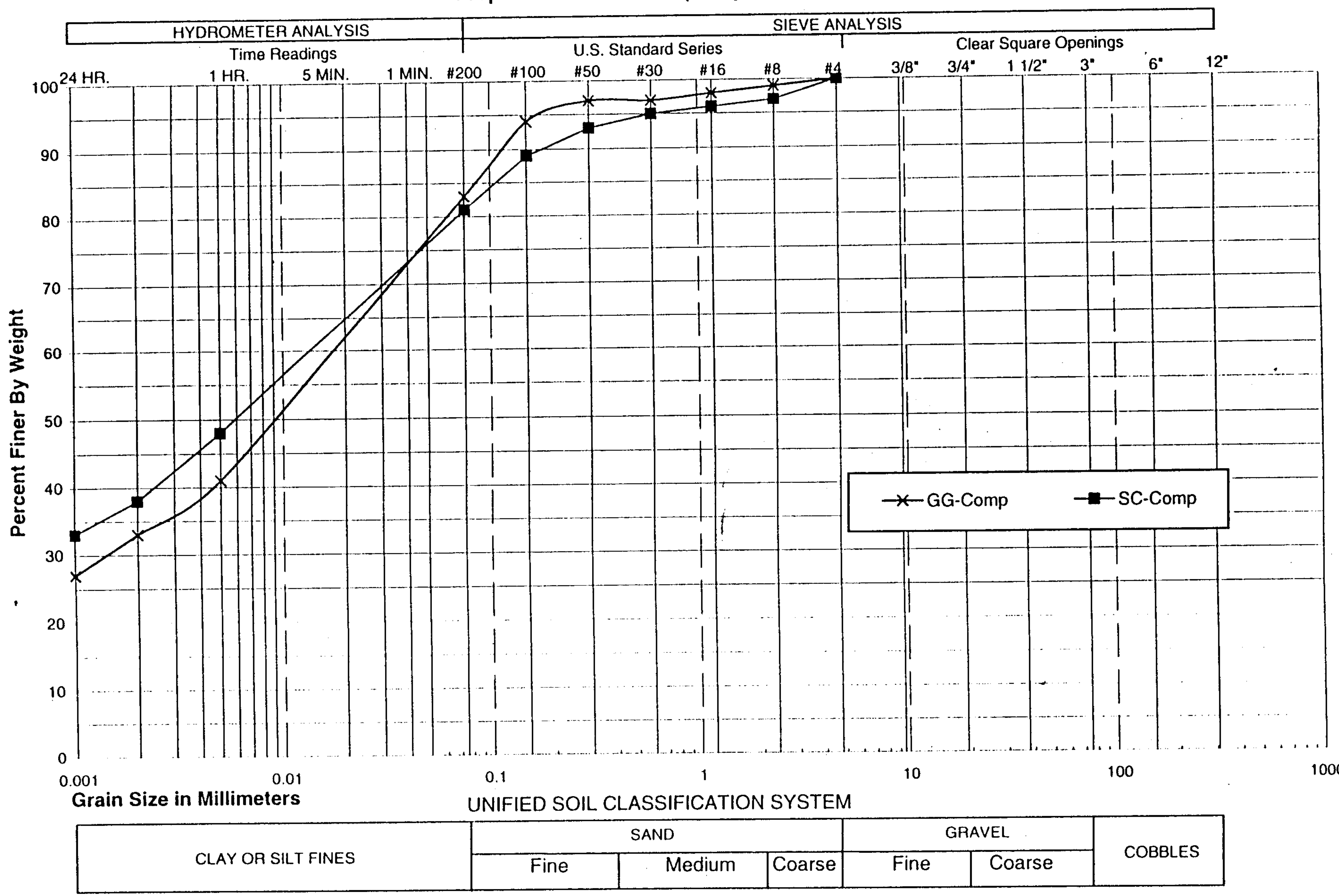


Figure 3.29

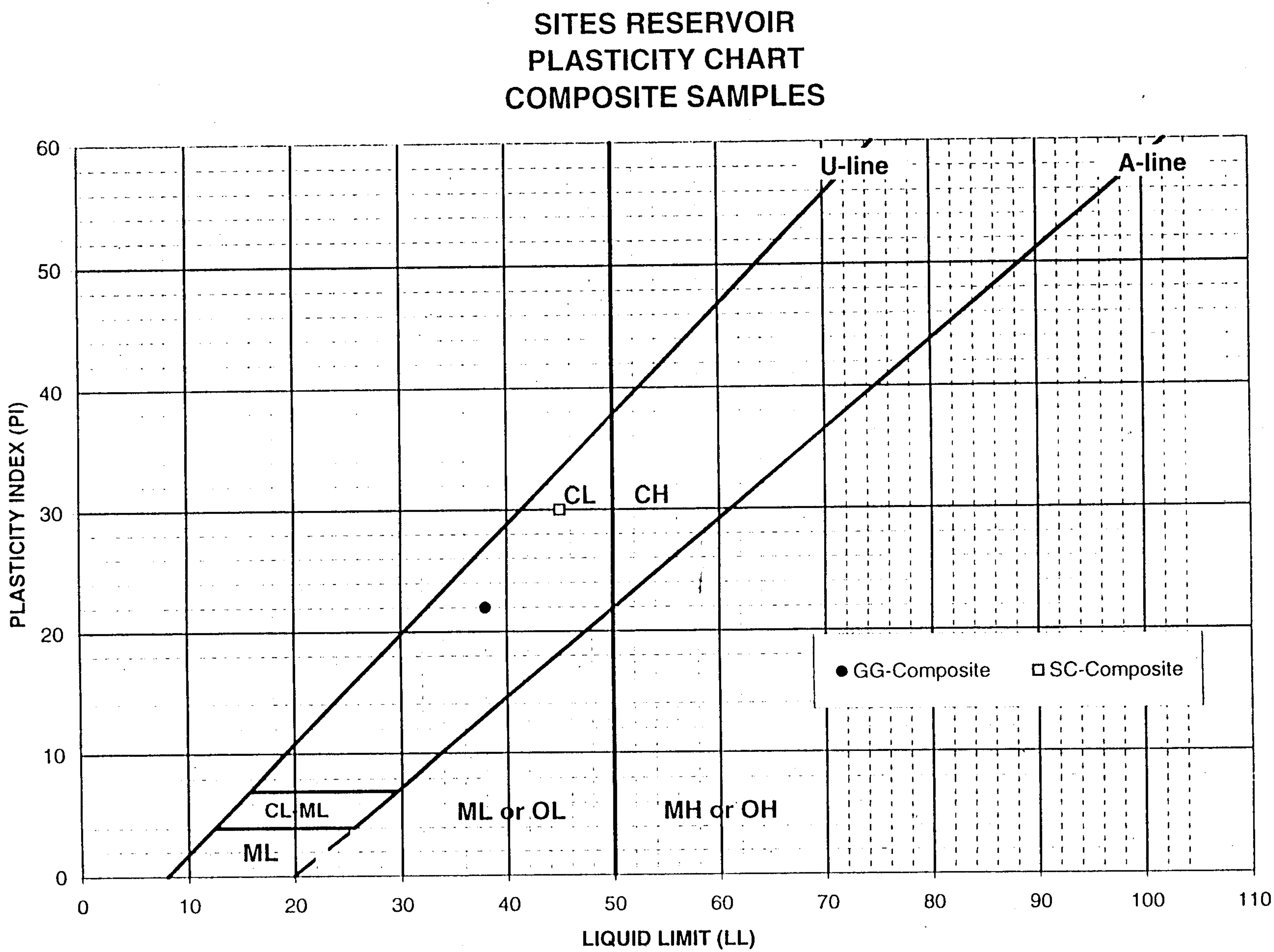
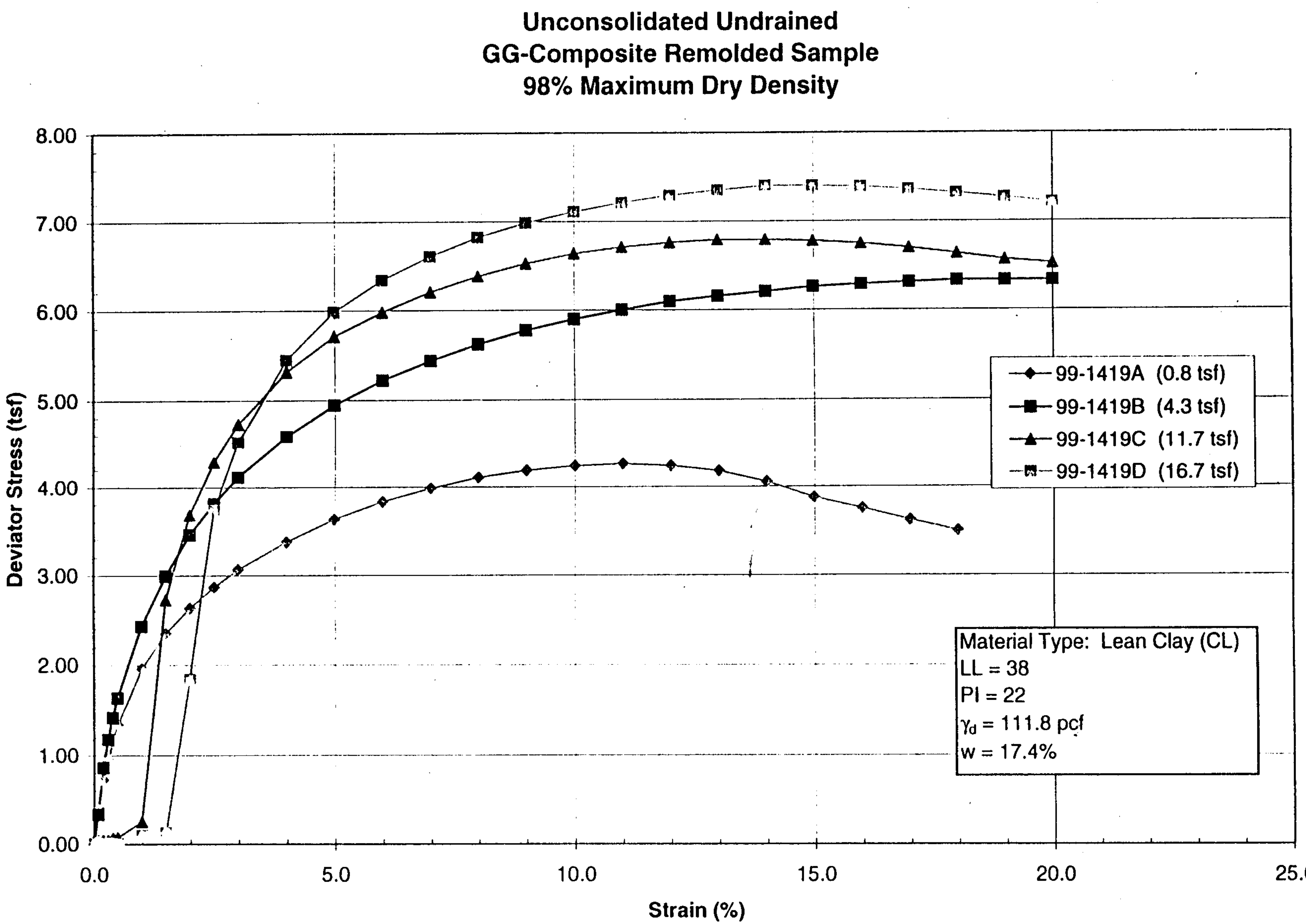
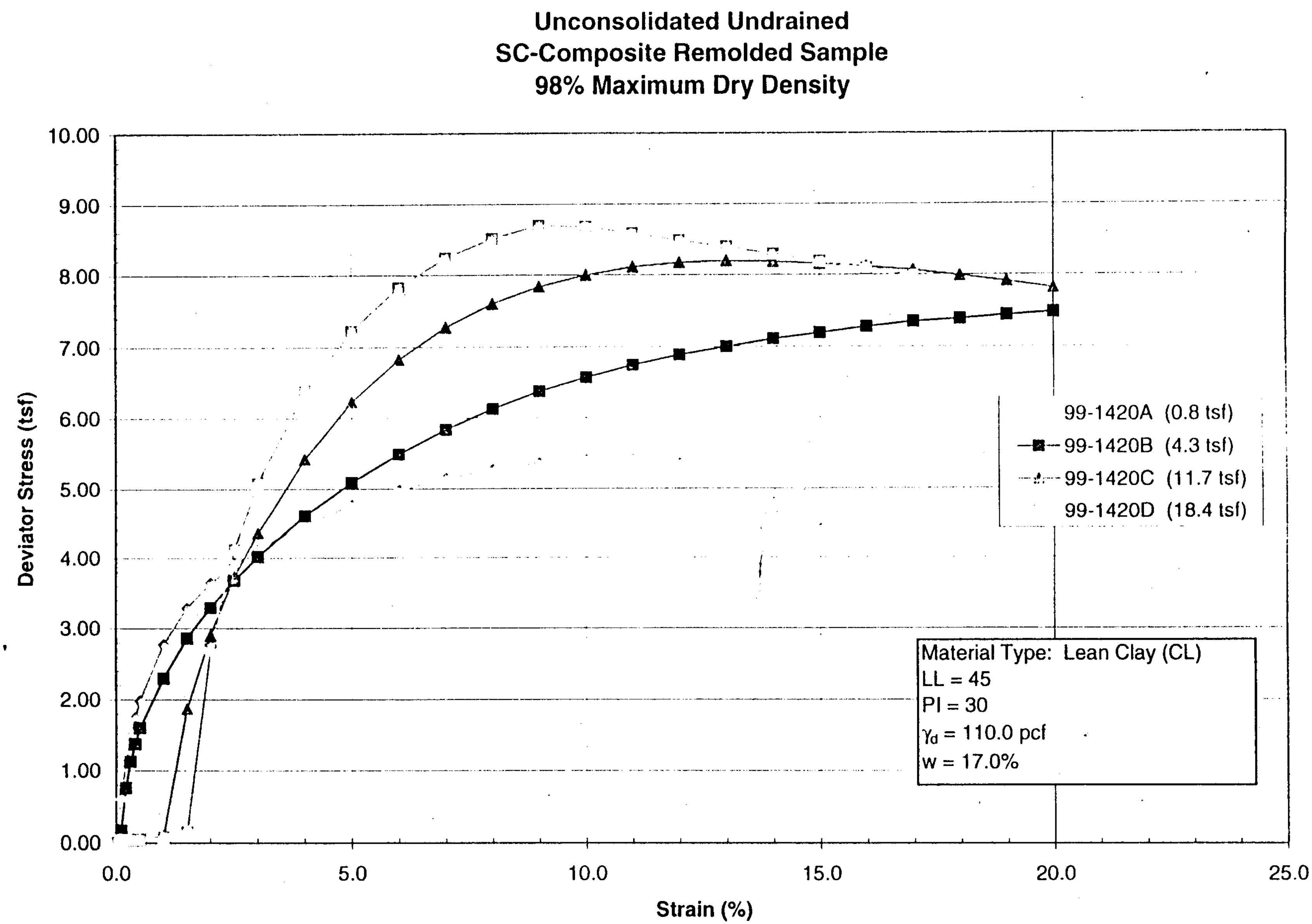

SITES RESERVOIR
PLASTICITY CHART
COMPOSITE SAMPLES
PLASTICITY INDEX (PI)
LIQUID LIMIT (LL)
0
10
20
30
40
50
60
70
80
90
100
110
U-line
A-line
CL
CH
CL-ML
ML
ML or OL
MH or OH
GG-Composite
SC-Composite

Figure 3.30



Unconsolidated Undrained
GG-Composite Remolded Sample
98% Maximum Dry Density
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Deviator Stress (tsf)
0.0
5.0
10.0
15.0
20.0
25.0
Strain (%)
99-1419A (0.8 tsf)
99-1419B (4.3 tsf)
99-1419C (11.7 tsf)
99-1419D (16.7 tsf)
Material Type: Lean Clay (CL)
LL = 38
PI = 22
γ_d = 111.8 pcf
w = 17.4%

Figure 3.31

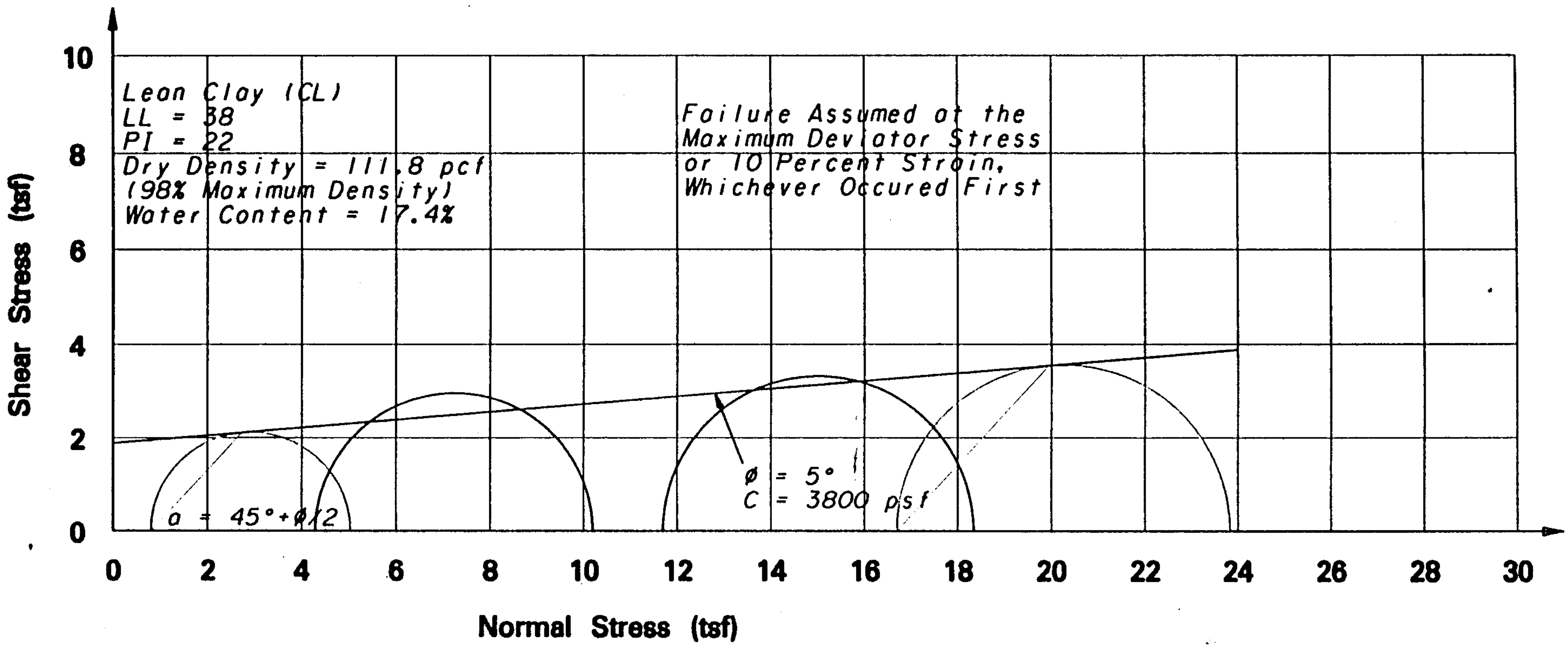


Unconsolidated Undrained
SC-Composite Remolded Sample
98% Maximum Dry Density
Deviator Stress (tsf)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.0
5.0
10.0
15.0
20.0
25.0
Strain (%)
99-1420A (0.8 tsf)
99-1420B (4.3 tsf)
99-1420C (11.7 tsf)
99-1420D (18.4 tsf)
Material Type: Lean Clay (CL)
LL = 45
PI = 30
γd = 110.0 pcf
w = 17.0%

Figure 3.32

SITES RESERVOIR STUDY

UU TEST – GG COMPOSITE
BRYTE LAB TEST SERIES NO. 99-1419

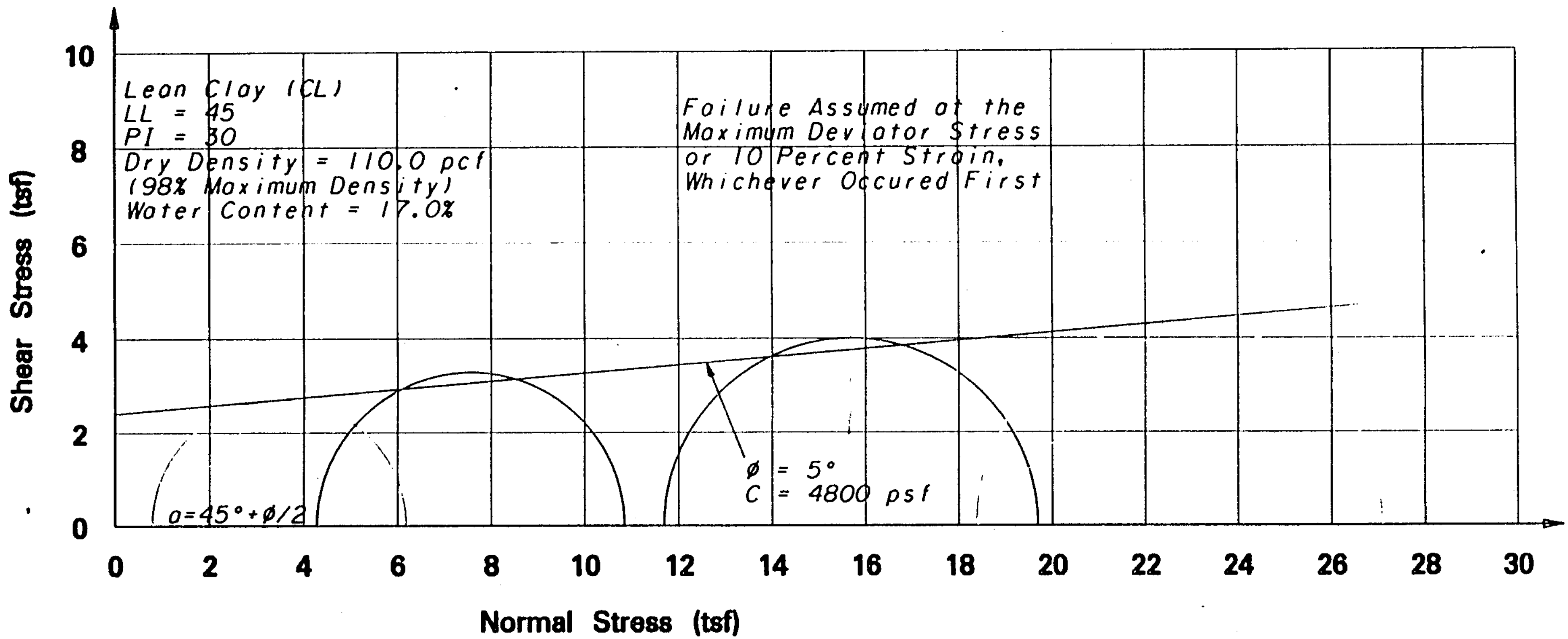


Confining Stress (tsf)	0.8	4.3	11.7	16.7
Lab Test No. 99-1419	A	B	C	E

Figure 3.33

SITES RESERVOIR STUDY

UU TEST – SC COMPOSITE
BRYTE LAB TEST SERIES NO. 99-1420



Confining Stress (tsf)	[illegible]	4.3	11.7	[illegible]
Lab Test No. 99-1420	A	B	C	[illegible]

FIGURE 3.34

Composite Sample SC

Make a composite sample using equal portions of the samples shown in bold (don't use samples 99-749, 99-750, 99-751, and 99-754).

LAB NO.	HOLE NO.	F.S, NO.	DEPTH (feet)
99-737	**SC-4**	**1**	**5**
99-738		**2**	**10**
99-739		**3**	**15**
99-740	**SC-5**	**1**	**5**
99-741		**2**	**10**
99-742	**SC-6**	**1**	**5**
99-743		**2**	**10**
99-744		**3**	**15**
99-745	**SC-7**	**1**	**5**
99-746		**2**	**10**
99-747	**SC-8**	**1**	**5**
99-748		**2**	**10**
99-749		*3*	*15*
99-750	*SC-9*	*1*	*5*
99-751		*2*	*10*
99-752	**SC-10**	**1**	**5**
99-753		**2**	**10**
99-754		*3*	*15*

Composite Sample GG

Make a composite sample using equal portions of the samples shown in bold (don't use samples 99-762, 99-765, 99-767, and 99-768).

LAB NO.	HOLE NO.	F.S. NO.	DEPTH (feet)
99-755	**GG-1**	**1**	**5**
99-756		**2**	**10**
99-757		**3**	**15**
99-758	**GG-2**	**1**	**5**
99-759		**2**	**10**
99-760		**3**	**15**
99-761	**GG-3**	**1**	**5**
99-762		*2*	*10*
99-763		**3**	**15**
99-764	**GG-4**	**1**	**4**
99-765		*2*	*8*
99-766	**GG-5**	**1**	**5**
99-767		*2*	*15*
99-768	*GG-6*	*1*	*3*
99-769	**GG-7**	**1**	**5**
99-770		**2**	**10**
99-771		**3**	**15**
99-772	**GG-8**	**1**	
99-773		**2**	**8**

Table 3.1

Physical Properties of Sandstone Rock Cores From Sites Quarry Material

Lab No.	Weathering	Unconfined Compressive Strength (psi) Dry	Unconfined Compressive Strength (psi) Wet	Young's Modulus ($x10^6$ psi) Dry	Young's Modulus ($x10^6$ psi) Wet	Poisson's Ratio Dry	Poisson's Ratio Wet	Brazilian Tensile Strength (psi) Dry	Brazilian Tensile Strength (psi) Wet	Orientation to Bedding
99C-62	Mod. Weathered	5511		0.945		0.06				
99C-55	Mod. Weathered	4842		0.896		0.16				
99C-59	Mod. Weathered	4640		0.906		0.10				
99C-53	Mod. Weathered		3790		0.663		0.10			
99C-59	Mod. Weathered		3516		0.730		0.11			
99C-61	Mod. Weathered		3461		0.813		0.15			
99C-66	Fresh	8994		1.303		0.22				
99C-69	Fresh	9983		1.262		0.15				
99C-73	Fresh	9727		1.209		0.14				
99C-70	Fresh		6904		1.157		0.22			
99C-72	Fresh		6818		1.188		0.14			
99C-74	Fresh		7227		1.196		0.13			
99C-54-3A	Mod. Weathered								182	parallel
99C-54-3B	Mod. Weathered								272	perpendicular
99C-54-3C	Mod. Weathered							247		parallel
99C-54-3D	Mod. Weathered							450		perpendicular
99C-56-5A	Mod. Weathered								172	parallel
99C-56-5B	Mod. Weathered								278	perpendicular
99C-56-5C	Mod. Weathered							235		parallel
99C-56-5D	Mod. Weathered							415		perpendicular
99C-58-7A	Mod. Weathered								174	parallel
99C-58-7B	Mod. Weathered								282	perpendicular
99C-58-7C	Mod. Weathered							279		parallel
99C-58-7D	Mod. Weathered							461		perpendicular
99C-60-9A	Mod. Weathered								145	parallel
99C-60-9B	Mod. Weathered								301	perpendicular
99C-60-9C	Mod. Weathered							304		parallel
99C-60-9D	Mod. Weathered							470		perpendicular
99C-67-2A	Fresh								394	parallel
99C-67-2B	Fresh								577	perpendicular
99C-67-2C	Fresh							617		parallel
99C-67-2D	Fresh							763		perpendicular
99C-71-6A	Fresh								433	parallel
99C-71-6B	Fresh								612	perpendicular
99C-71-6C	Fresh							561		parallel
99C-71-6D	Fresh							798		perpendicular
99C-75-10A	Fresh								342	parallel
99C-75-10B	Fresh								367	perpendicular
99C-75-10C	Fresh							626		parallel
99C-75-10D	Fresh							629		perpendicular
99C-78-13A	Fresh								318	parallel
99C-78-13B	Fresh								508	perpendicular
99C-78-13C	Fresh							539		parallel
99C-78-13D	Fresh							754		perpendicular

TABLE 3.2

Average Physical Properties of Rock Cores

Source	Rock Type	Unconfined Compressive Strength (psi)		Young's Modulus ($x10^6$ psi)		Poisson's Ratio		Brazilian Tensile Strength (psi)		Reference
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	
Sites Quarry	Sandstone (F)	9568	6983	1.258	1.180	0.170	0.164	661	444	
Sites Quarry	Sandstone (MW)	4998	3589	0.916	0.735	0.107	0.120	358	226	
Sites Quarry	Sandstone (A)	8845	4797	1.93	1.45	0.220		1133		1
Newville	Sandstone	22160	12160	3.210	2.610	0.13	0.29	1898	1120	2
Newville	Conglomerate	16800	5750	4.260	2.780	0.15	0.47	1522	844	2
Oroville	Amphibolite	45500	28000	6.200	6.200			1870		2
Oroville	Quartz Schist	48400	29500	10.200	6.800	0.30		2590		2
Oroville	Granulite	17000		2.850						2
Pyramid	Argillite	15000		4.200				1896		2

F-Fresh, MW-Moderately Weathered, A-Average

1. Becker, Chan, and Seed, UC Berkeley Report No. TE 72-3 "Strength and Deformation Characteristics of Rockfill Materials in Plane Strain and Triaxial Compression Tests"
2. DWR "SWP Future Supply Program Glenn Reservoir Complex, Investigation of Rockfill Materials for Newville Dam," December 1980

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

SANDSTONE AGGREGATES TESTING SUMMARY

DIVISION OF ENGINEERING
CIVIL ENGINEERING
CANALS AND LEVEES SECTION

PROJECT: Sites and Golden Gate Dams

FEATURE: Venado Sandstone Quality for Rip-Rap and RCC Aggregate

LAB. NO.	HOLE NO.	F.S. NO.	PERCENT FINER – MECHANICAL ANALYSIS – GRAVEL 3"	1 1/2"	3/4"	3/8"	4	SAND 8	16	30	50	100	200	ASTM C-29 D.R.U.W. (pcf)	ASTM C-40 as rec'd	ASTM C-40 washed fines removed	ASTM C-127 & 128 3/4" x 3/8" spg (ssd)	3/4" x 3/8" % abs.	3/8" x #4 spg (ssd)	3/8" x #4 % abs	#4 x #200 spg (ssd)	#4 x #200 % abs	ASTM C-131 100 rev. % loss	ASTM C-131 500 rev. % loss	ASTM C-142 % clay lumps and friable particles 3/4x 3/8	3/8x #4	#4x#8
99C-113		A		100	96	32	12	9	8	7	6	4	2	88.3	clear	clear	2.48	4.9	2.48	6.3	2.57	2.40	11.4	50.8	1.0	2.1	6.5
"		B		100	95	57	35	28	23	20	18	11	6	88.7	clear	clear	2.49	5.0	2.48	6.3	2.58	2.30	7.3	36.9	0.2	0.1	1.7
"		C		100	97	65	44	36	30	27	24	16	9	88.6	clear	clear	2.48	5.4	2.48	6.2	2.58	2.50	11.5	49.5	0.2	0.1	1.3
99C-114		A		100	97	51	22	17	14	12	11	7	4	86.2	2	clear	2.45	6.2	2.47	6.6	2.56	2.70	13.7	56.0	1.7	3.3	8.6
"		B		100	97	55	27	19	15	13	11	7	4	86.4	3	clear	2.46	6.0	2.47	6.6	2.57	2.70	9.2	43.5	0.2	0.4	3
"		C		100	95	47	22	16	13	12	10	6	3	87.5	3	clear	2.46	6.0	2.46	6.6	2.57	2.70	12.5	54.5	0.4	0.9	3.7

100 PERCENT COARSE AGGREGATE

LAB. NO.	HOLE NO.	F.S. NO.	3"	1 1/2"	3/4"	3/8"	4	8	16	30	50	100	200
99C-113		A		100	95	22	0						
"		B		100	92	34	0						
"		C		100	95	38	0						
99C-114		A		100	96	37	0						
"		B		100	96	39	0						
"		C		100	93	33	0						

100 PERCENT FINE AGGREGATE

LAB. NO.	HOLE NO.	F.S. NO.	3"	1 1/2"	3/4"	3/8"	4	8	16	30	50	100	200
99C-113		A					100	73	61	56	50	32	18
"		B					100	78	65	58	51	32	16
"		C					100	81	68	61	54	36	21
99C-114		A					100	76	62	54	47	30	16
"		B					100	68	55	47	40	27	16
"		C					100	74	60	53	45	29	16

Sheet 1 o

DATE: 6/15/1999
INITIAL: RGJ
REQUEST NO.: 99-19

REMARKS: 99c-113 = fresh crushed sandstone.
99c-114 = weathered crushed sandstone.

IM - INSUFFICIENT MATE
NP - NON-PLASTIC
NG - NO GOOD

Table 3.4

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CLASSIFICATION TEST SUMMARY

DIVISION OF ENGINEERING
CIVIL ENGINEERING
CANALS AND LEVEES SECTION

PROJECT: Sites Dam

FEATURE:

LAB NO.	HOLE NO.	F.S. NO.	DEPTH (feet)	PERCENT FINER – MECHANICAL ANALYSIS – GRAVEL					SAND						HYDROMETER – SILT & CLAY			ATTERBERG LIMITS		MOISTURE CONTENT %	PERCENT ORGANIC	GROUP SYMBOL	CLASSIFICATION GROUP NAME
				3.0'	1.5"	3/4"	3/8"	4	8	16	30	50	100	200	5m	2m	1m	LL	PI				
99-737	SC-4	1	5									100	97	88				35	20			CL	Lean clay
99-738		2	10					100	99	99	98	98	95	87				39	25			CL	Lean clay
99-739		3	15					100	99	99	98	97	96	94				52	37			CH	Fat clay
99-740	SC-5	1	5						100	99	98	97	96	91				46	31			CL	Lean clay
99-741		2	10					100	99	97	95	94	92	87				57	42			CH	Fat clay
99-742	SC-6	1	5			100	99	99	98	97	96	94	88	80				49	35			CL	Lean clay with sand
99-743		2	10					100	98	97	96	94	89	83				54	38			CH	Fat clay with sand
99-744		3	15			100	98	97	87	82	79	75	68	60				46	30			CL	Sandy lean clay
99-745	SC-7	1	5					100	99	96	94	92	90	88				51	36			CH	Fat clay
99-746		2	10			100	99	99	96	92	87	82	78	73				42	25			CL	Lean clay with sand
99-747	SC-8	1	5		100	99	99	98	96	94	91	87	81	74				43	29			CL	Lean clay with sand
99-748		2	10			100	99	99	96	93	90	85	72	60				40	26			CL	Sandy lean clay
99-749		3	15		100	98	94	91	78	72	68	61	47	38				35	20			CL	Clayey sand
99-750	SC-9	1	5							100	99	99	98	97				72	51			CH	Fat clay
99-751		2	10						100	99	98	98	97	97				66	46			CH	Fat clay
99-752	SC-10	1	5								100	99	95	85				41	24			CL	Lean clay with sand
99-753		2	10					100	99	99	99	99	95	85				41	25			CL	Lean clay with sand
99-754		3	15	100	86	86	80	77	70	67	65	60	53	44				36	21			CL	Clayey sand with gravel
99-755	GG-1	1	5						100	99	99	99	96	87				34	19			CL	Lean clay
99-756		2	10					100	99	98	97	97	96	90				45	28			CL	Lean clay
99-757		3	15					100	97	95	94	93	91	85				41	24			CL	Lean clay
99-758	GG-2	1	5								100	99	96	85				35	19			CL	Lean clay with sand
99-759		2	10							100	99	98	92	77				34	18			CL	Lean clay with sand
99-760		3	15							100	99	98	93	79				33	16			CL	Lean clay with sand
99-761	GG-3	1	5								100	99	95	79				36	19			CL	Lean clay with sand
99-762		2	10					100	94	90	87	81	73	62				32	15			CL	Sandy lean clay
99-763		3	15									100	97	84				33	16			CL	Lean clay with sand
99-764	GG-4	1	4					100	99	98	98	98	96	90				42	25			CL	Lean clay
99-765		2	9									100	99	91				37	22			CL	Lean clay

DATE: 8/17/99
INITIAL:
REQUEST NO.: 99-35

REMARKS:

IM - INSUFFICIENT MATERIAL
NP - NON-PLASTIC
NG - NO GOOD

Table 3.5

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CLASSIFICATION TEST SUMMARY

DIVISION OF ENGINEERING
CIVIL ENGINEERING
CANALS AND LEVEES SECTION

PROJECT: Sites Dam

FEATURE:

LAB NO.	HOLE NO.	F.S. NO.	DEPTH (feet)	PERCENT FINER														ATTERBERG LIMITS		MOISTURE CONTENT	PERCENT ORGANIC	GROUP SYMBOL	CLASSIFICATION GROUP NAME
				MECHANICAL ANALYSIS											HYDROMETER SILT & CLAY								
				GRAVEL					SAND														
				3.0'	1.5"	3/4"	3/8"	4	8	16	30	50	100	200	5m	2m	1m	LL	PI	%			
99-766	GG-5	1	5					100	98	96	95	94	92	89				59	42			CH	Fat clay
99-767		2	15			100	99	99	97	94	89	84	68	55				31	14			CL	Sandy lean clay
99-768	GG-6	1	3					100	99	98	97	97	94	90				52	37			CH	Fat clay
99-769	GG-7	1	5									100	98	86				35	18			CL	Lean clay
99-770		2	10					100	99	99	98	98	96	85				33	16			CL	Lean clay with sand
99-771		3	15					100	99	98	98	98	96	84				30	12			CL	Lean clay with sand
99-772	GG-8	1				100	99	98	96	95	94	93	90	84				54	38			CH	Fat clay with sand
99-773		2	8					100	96	92	91	90	88	87				44	24			CL	Lean clay

DATE: 8/17/99
INITIAL:
REQUEST NO.: 99-35

REMARKS:

IM - INSUFFICIENT MATERIAL
NP - NON-PLASTIC
NG - NO GOOD

Table 3.5

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CLASSIFICATION TEST SUMMARY

DIVISION OF ENGINEERING
CIVIL ENGINEERING
CANALS AND LEVEES SECTION

PROJECT: Sites Dam

FEATURE: Composite Samples

LAB. NO.	HOLE NO.	F.S. NO.	DEPTH (feet)	PERCENT FINER														ATTERBERG LIMITS		MOISTURE CONTENT	PERCENT ORGANICS	GROUP SYMBOL	CLASSIFICATION GROUP NAME
				MECHANICAL ANALYSIS											HYDROMETER								
				GRAVEL				SAND							SILT & CLAY								
				3.0"	1.5"	3/4"	3/8"	4	8	16	30	50	100	200	5M	2M	1M	L.L.	P.I.	%			
99-1419	GG - Samples							100	99	98	97	97	94	83	41	33	27	38	22		3.9	CL	Lean clay w/sand
99-1420	SC - Samples							100	97	96	95	93	89	81	48	38	33	45	30		4.2	CL	Lean clay w/sand

DATE: 9/28/99

INITIAL: dmt

REQUEST NO.: 99-51

REMARKS: 99-1419: Specific Gravity - 2.74; Max. Dry Density - 111.8pcf; Opt. Moist. - 17.4%
99-1420: Specific Gravity - 2.74; Max. Dry Density - 110.0pcf; Opt. Moist. - 17.0%

IM - INSUFFICIENT MATERIAL
NP - NON-PLASTIC
NG - NO GOOD